The State Water Project Delivery Reliability Report

DRAFT

August 2002

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Governor
State of California

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Foreword

The Department of Water Resources is issuing this report to assist the contractors of the State Water Project in the assessment of the adequacy of the SWP component of their overall water supplies. SWP delivery reliability is of direct interest to them and those they serve because it is an important element of their overall water supply.

Local supply reliability is of key importance to local planners and local government officials who have the responsibility to plan for future growth while assuring an adequate and affordable water supply is available for the existing population and businesses. This function is usually conducted in the course of preparing a water management plan such as the Urban Water Management Plans required by Water Code Section 10610. Information in this report may be used by local agencies in preparing or amending their water management plans and identifying the new facilities or programs that may be necessary to meet future water needs.

Local agencies will also find this report useful in conducting analyses mandated by recent legislation authored by Senator Sheila Kuehl (SB 221) and Senator Jim Costa (SB 610). These new laws require water retailers to demonstrate the sufficiency of their water supplies for certain proposed subdivisions and development projects subject to the California Environmental Quality Act.

The Department is available to assist local agencies in the development of Urban Water Management Plans, the development of water conservation programs, and in applying the information contained in this draft report to specific water users. In the near future, DWR will be publishing a draft guidebook on how cities and counties can comply with Senate Bills 221 and 610.

The SWP Delivery Reliability Report is being issued as a public draft. The Department of Water Resouces will be conducting public meetings to discuss the report and receive comments. We expect the comments received from the public will help to produce a final report that is clear and very useful to SWP contractors and the districts they serve.

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The State Water Project Delivery Reliability Report

Preface

Will there be enough water? Public officials throughout California face this question with increasing frequency as growth and competing uses strain existing resources. Water supply, however, has always been an uncertain and contentious matter in our State. For many years, the Department of Water Resources (DWR) has investigated this question. At its simplest level, the question might be, "How many wells are needed for a rural town's water supply?" or "How many people can a 100,000 acre-foot reservoir serve?" But for most areas of the State, the evaluation of water supply adequacy is not simple. The answer requires a complex analysis, taking into account multiple sources of water, a range of uses, the timing of use, hydrology, available facilities, regulatory restraints, and, of course, future weather patterns. Most water users in California live in areas with multiple sources of water. Typically, local water providers "mix and match" these sources to maximize water supply and quality and to minimize cost. The answer to the question of water supply adequacy must take into account this mix-and-match practice and incorporate information about all water sources and their interrelation.

Much of the Department's work in investigating the State's water supply has focused on the State Water Project. SWP supplies two-thirds of the State's population with a portion of its water supply and provides water to irrigate, in part, 600,000 acres of agriculture. This draft report presents DWR's current information regarding the annual water delivery reliability of the SWP. The report does not analyze how specific local water agencies integrate SWP water into their water supply equation. That topic requires extensive information about local facilities, local water resources, and local water use, which is beyond the scope of this report. Moreover, such an analysis would require decisions about water supply and use that traditionally have been made at the local level. The Department believes it is appropriate that local officials continue to fill this role. This report does provide examples under various scenarios that explain how the SWP supply can be integrated into local water management.

This report is being released as a draft report for public review. During the public review period, Department representatives will hold public meetings throughout SWP service areas to discuss this report and receive comments. A schedule of these workshops can be found on the Web site for this report (http://swpdelivery.water.ca.gov). The review period will close November 1, 2002. Interested parties may send written comments to:

Attention: SWP Water Delivery Report
California Department of Water Resources
P. O. Box 942836
Sacramento, California 94236-0001

DWR will send the final report to city, county, local, and regional planning agencies within the SWP service area. The Department will update this report every two years or more frequently should study factors change significantly or if improvement in analytical tools warrants an earlier release.

Purpose

This report provides current information on the ability of the SWP to deliver water under existing and future levels of development, assuming historical patterns of precipitation. The SWP delivers water under long-term contracts to 29 public water agencies throughout the State. They, in turn, either deliver water to water wholesalers or retailers or deliver it directly to agricultural and urban water users. This report first looks at the general subject of water delivery reliability, discusses how it is

Senate Bill 221

This law amends Section 11010 of the Business and Professions Code and Section 65867.5 of the Government Code. It also adds Sections 66455.3 and 66473.7 to the Government Code.

> Under the Subdivision Map Act, a legislative body of a city or county is required to deny approval of a tentative map, or a parcel map for which a tentative map is not required, if it makes any of a number of findings. Under the Planning and Zoning Law, a city, county, or city and county may not approve a development agreement unless the legislative body finds that the agreement is consistent with the general plan and any applicable specific plan. [SB 221 prohibits] approval of a tentative map, or a parcel map for which a tentative map was not required, or a development agreement for a subdivision of property of more than 500 dwelling units, except as specified, including the design of the subdivision or the type of improvement, unless the legislative body of a city or county or the designated advisory agency provides written verification from the applicable public water system that a sufficient water supply is available or, in addition, a specified finding is made by the local agency that sufficient water supplies are, or will be, available prior to completion of the project.
>
> (From Legislative Counsel's Digest of Senate Bill No. 221, 2001-2002 session, filed with Secretary of State Oct. 9, 2001, Chapter 642:88-89)

An exception is made for the County of San Diego if the Governor's Office of Planning and Research determines certain conditions are met.

determined by the Department for the SWP, and provides estimates of SWP delivery reliability today and in the future. It then discusses the role this reliability plays in the determination of overall water supply reliability for local water agencies.

The water delivery reliability of the SWP is of direct interest to those who use SWP supplies because it is an important element in the overall water supply in those areas. Local supply reliability is of key importance to local planners and local government officials who have the responsibility to plan for future growth while assuring that an adequate and affordable water supply is available for the existing population and businesses. This function is usually conducted in the course of preparing a water management plan such as the Urban Water Management Plans required by Water Code Section 10610. The information in this report may be used by local agencies in preparing or amending their water management plans and identifying the new facilities or programs that may be necessary to meet future water demands.

Local agencies also will find in this report information that is useful in conducting analyses mandated by recent legislation authored by Senator Sheila Kuehl (SB 221) and Senator Jim Costa (SB 610). These new laws require water retailers to demonstrate whether their water supplies are sufficient for certain proposed subdivisions and development projects subject to the California Environmental Quality Act. In the near future, DWR will be publishing a draft guidebook on how cities and counties can comply with Senate Bills 221 and 610. That guidebook will include suggestions on how local water suppliers can integrate supplies from other sources such as the SWP into their analyses.

This report also responds to the recent criticisms of the Department in its administration of the SWP. Comments on the Monterey Amendment Environmental Impact Report stated that local planners and public officials were relying on inflated estimates of water supply from the SWP in approving new development. This report will provide local officials with a single source of the most current data available on SWP delivery reliability for use in local planning decisions.

Senate Bill 610

This law amends Section 21151.9 of the Public Resources Code, and Sections 10631, 10656, 10910, 10911, 10912, and 10915 of the Water Code. It also repeals Section 10913 and adds and expires Section 10657 of the Water Code.

> This [law requires] additional information be included as part of an urban water management plan if groundwater is identified as a source of water available to the supplier. [It] requires an urban water supplier to include in the plan a description of all water supply projects and programs that may be undertaken to meet total projected water use. [It prohibits] an urban water supplier that fails to prepare or submit the plan to the [California Department of Water Resources] from receiving funding made available from specified bond acts until the plan is submitted. The law, until January 1, 2006, requires the department to take into consideration whether the urban water supplier has submitted an updated plan, as specified, in determining eligibility for funds made available pursuant to any program administered by the department.
>
> [In addition, the law] requires a city or county that determines a project is subject to the California Environmental Quality Act to identify any public water system that may supply water for the project and to request those public water systems to prepare a specified water supply assessment, except as otherwise specified. [It requires] the assessment include, among other information, an identification of existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project and water received in prior years pursuant to those entitlements, rights, and contracts. The [law requires] the city or county, if it is not able to identify any public water system that may supply water for the project, to prepare the water supply assessment after a prescribed consultation.
>
> The [law prescribes] a timeframe within which a public water system is required to submit the assessment to the city or county and would authorize the city or county to seek a writ of mandamus to compel the public water system to comply with requirements relating to the submission of the assessment.
>
> [It requires] the public water system, or the city or county, as applicable, if that entity concludes that water supplies are, or will be, insufficient, to submit the plans for acquiring additional water supplies. [It also requires] the city or county to include the water supply assessment and certain other information in any environmental document prepared for the project pursuant to the act.
>
> (From Legislative Counsel's Digest of Senate Bill No. 610, 2001-2002 session, filed with Secretary of State Oct. 9, 2001, Chapter 643:94-95.)

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I
Water Delivery Reliability In General

What is Water Delivery Reliability?

"Water delivery reliability" means how much one can count on a certain amount of water being delivered to a specific place at a specific time.

Objectively, water delivery reliability indicates a particular amount of water that can be delivered with a certain numeric frequency. A delivery reliability analysis assesses such things as facilities, system operation, and weather projections.

Subjectively, water delivery reliability indicates an acceptable or desirable level of dependability of water deliveries to the people receiving the water. Usually, a local water agency in coordination with the public it serves determines the acceptable level of reliability and plans for new facilities, programs, or additional water supply sources to meet or maintain this level.

What Factors Determine Water Delivery Reliability?

In its simplest terms, water delivery reliability depends on three general factors:

1) Availability of water from the source (that is, the natural source or sources of the water from which the supplier draws—the particular watercourse or groundwater basin). Availability of water from the source depends on the amount and timing of precipitation and runoff, or "hydrology," which provides water to the stream or groundwater basin, and the anticipated patterns of use and consumption of the source water by others, including water returned to the source after use.
2) Availability of means of conveyance (that is, the means for conveying the water from the source via pumps, diversion works, reservoirs, canals, etc. to its point of delivery). The ability to convey water from the source depends on the existence and physical capacity of the diversion, storage, and conveyance facilities and also on any contractual, statutory, and regulatory limitations on the use of the facilities.
3) The level and pattern of water demand at the place of delivery. The level of demand for water at the place of delivery is defined by the magnitude of the demand, types of uses, local weather patterns, costs, and other factors. Supply from a water system may be sufficiently reliable at a low level of demand but may become less reliable as the demand increases. In other cases under increased demand, the water supply system may be able to deliver more water than in the past and maintain its reliability because use of the system's facilities had not been maximized.

How is Water Delivery Reliability Determined?

Water Delivery Reliability is Defined for a Specific Point in Time

For this report, water delivery reliability is analyzed for 2001 conditions and for conditions projected to exist 20 years in the future (2021). These analyses must describe current conditions adequately and make predictions about the three factors described earlier.

The Availability of Water at the Source

This factor depends on how much rain and snow there will be in any given year and what the level of development (that is, the use of water) will be in the source areas.

While no model or tool can predict what actual, natural water supplies will be for any year or years, and until we are able to evaluate climate change in California, future weather patterns will be assumed similar to those in the past, especially where there is a long historical rainfall record.

The SWP analyses contained in this report are based upon 73 years of historical records for rainfall and runoff that have been adjusted to reflect the current and future levels of development by analyzing land use patterns in the source areas and projecting future land and water use. These series of data are then used to forecast the amount of water available to the SWP under current and future conditions.

Recent studies on climate change conclude a warming trend exists that could change the long-term behavior of rainfall and snowmelt. Higher temperatures could have a large impact on natural runoff, especially in the lower elevation northern Sierra. If precipitation amounts are assumed to not change significantly, global warming would mean less snow forming in the lower elevations and less snowpack overall. These conditions would result in more direct rainfall runoff during the winter and less spring runoff due to snowmelt. Regional climate model studies by researchers at Scripps Institution of Oceanography indicate a reduction in snow water equivalent by about one-third to one-half current levels by the middle and end of the century, respectively. A recent model study released by UC Santa Cruz researchers that studied climate response to increases in atmospheric carbon dioxide concluded that Sierra snow accumulation would decrease everywhere and precipitation would increase in the northern regions by about 25 percent. Snowpack would also be gone by the end of April. Streamflow studies by researchers at Lawrence Berkeley National Laboratory for the Feather River show a shift to increased flows before March/April and lower flows the following months. The impact of this trend upon SWP water supply will be analyzed as more information becomes available. Global warming is being evaluated as part of the *2003 California Water Plan Update* (Bulletin 160). Information on Bulletin 160 is available on the Department's Web site, www.waterplan.water.ca.gov.

The Ability to Convey Water from the Source to the Desired Point of Delivery

This factor describes the facilities available to capture and convey surface water or groundwater and the institutional limitations placed upon the facilities. The facilities and institutional limitations may be assumed to be those currently existing. Alternatively, predictions may be made regarding planned new facilities. Assumptions made about the institutional limitations to operation—such as legal, contractual, or regulatory restrictions—often are based upon existing conditions. Future changes in conditions that affect the ability to convey water usually cannot be predicted with certainty, particularly the regulatory and other institutional constraints on water conveyance.

Although new facilities are planned to increase the water delivery capability of the SWP, the analyses contained in this report assume no additional facilities in order to provide a conservative estimate of water delivery reliability. The analyses also assume current institutional limitations will exist 20 years in the future (2021).

The Level of Demand

This factor includes the amount and pattern of demand upon the water system. Demand can have a significant effect upon the reliability of a water system. For example, if the demand occurs only three months in the summer, a water system with a sufficient annual supply but insufficient water storage may not be able to reliably meet the demand. If, however, the same amount of demand is distributed over the year, the system could more easily meet the demand because the need for water storage is reduced.

Demand levels for the SWP are derived from historical data and information received from the SWP contractors. Demand on the SWP is nearing the full Table A amount. Each contractor has a Table A, which lists acre-feet amounts per year, usually increasing over time. Most contractors' Table A amounts reached the maximum in 1990. The total of all contractors' maximum Table A amounts is 4.173 million acre-feet (maf). Table A is used to define each contractor's proportion of the available water supply that the Department will allocate and deliver to that contractor. The Table A amounts in any particular contract, accordingly, should not be read as a guarantee of that amount but rather as the tool in an allocation process that defines an individual contractor's "slice of the pie." The size of the "pie" itself is determined by the factors described in this report. (See Appendix C for additional explanation and listing of the maximum Table A amounts.) There are 29 contractors of the SWP. Yuba City, Butte County, and Plumas County Flood Control and Water Conservation District are north of the Delta. Their maximum Table A amounts total 0.040 maf. The maximum Table A amounts for the remaining 26 contractors, which receive their supply from the Delta, total 4.133 maf. This report focuses on SWP deliveries from the Delta because the amount of water pumped from the Delta by SWP facilities is the most significant component of the total amount of SWP deliveries. The results presented in this report regarding the percent of Table A deliveries applies to Yuba City, Butte County, and Plumas County Flood Control and Water Conservation District in the same manner as the other contractors. For year 2001, SWP demands from the Delta are estimated to vary from 3.0 to 4.1 maf per year depending upon the weather conditions in the demand areas. For the year 2021, the demand is estimated two ways. The first is to assume the demand depends upon weather conditions (study 2021A). This method is consistent with the one used for the 2001 study and produces a demand that varies from 3.3 to 4.1 maf per year. The increase in the value of the lower end of the range between the 2001 and 2021 levels is due to a projected increase in population and land development in the service areas. The value of the upper end of the range cannot rise above 4.1 maf because it is at the maximum Table A amount. The second estimation method is to assume that the contractors' demands will be their maximum Table A amount, 4.1 maf per year, regardless of the weather in the demand areas (study 2021B). The results from this study provide information on the significance of the weather-variability assumption for 2021 and give an indication of the additional water supply that could be made available to the SWP contractors if places were available to store it.

Past Deliveries Cannot Accurately Predict Future Deliveries

It is worthwhile to note that actual, historical water deliveries cannot be used with a significant degree of certainty to predict what water deliveries will be. As discussed earlier, there are continual, significant changes over time in the determinants of water delivery: changes in water storage and delivery facilities, in water use by others, in water demand, and in the regulatory constraints on the use of facilities for the delivery of water. Given the very significant historical changes that have occurred, past deliveries are not necessarily good predictors of current deliveries, much less of future deliveries.

For example, the demand 30 years ago for water from the SWP was not as high as it is currently or expected to be in the future. Because the need for SWP water then was relatively low, less water was transported through the SWP during normal and wet times than could have been if the demand had been higher. Simply put, less water was delivered in those past years because less water was needed. Conversely, the current or projected delivery capability of a water project would be less than the past if (1) demand for water from a water project had been at its maximum level for many years, (2) no new facilities had been built, and (3) the supply from one of its main sources of water had recently been reduced because another entity with a prior water right increased its use of that source.

Many Assumptions Must Be Made in the Determination and Analysis of Water Delivery Reliability

As discussed earlier, to plan for the future, many assumptions must be made about the future. One of the most significant assumptions for water planning in general is how wet or dry the weather will be. For many planning purposes, the assumption is that future patterns of weather will be like the past, and an effort is made to develop information on the longest historical period for which acceptable records exist.

Using the historical record, planners analyze the worst drought in the period of record to evaluate how the water system will respond. Precipitation information for the Central Valley used for this report begins in 1922 and records the area's worst drought from 1928 to 1934, although the brief 1976 to 1977 drought was more acutely dry. Whatever assumptions are made, every responsible water delivery reliability analysis should expressly set forth the assumptions used in arriving at the number or numbers produced. It should always be understood that those numbers depend on, and are no better than, the assumptions upon which they must necessarily rest.

Because assumptions are the foundation upon which the estimates are made, people reviewing the estimates may wonder about the impact any particular assumption has upon the study results. For example, what impact would a significant increase in water use in the source areas have upon the projected SWP water delivery reliability? Would it significantly reduce the amount of SWP supply and, if so, by how much? These types of questions can be answered by varying specific factors to see the impact upon the results. These studies are referred to as sensitivity analyses and can be helpful in assessing the importance of certain assumptions to the study results. Sensitivity studies will be done in the near future on SWP water delivery analyses.

II
Determining Water Delivery Reliability

Study Assumptions

The selection of the assumptions and the factors that go into the determination of future water delivery reliability is very important and must be tailored to the particular water supplier. Assumptions and factors for the SWP concern, in particular, Sacramento and San Joaquin river basin precipitation; water rights and uses; SWP storage and conveyance facilities, including diversion facilities in the Delta; SWP service area demand; and the statutes, regulations, and contractual provisions that govern and regulate the SWP, including coordinating operations with the federal Central Valley Project. A detailed list of the study assumptions for this report are contained in Appendix A.

The assumptions for the studies for this report are the same across all studies except for two elements: the projected water use in the source areas and assumed SWP demands. Water use in the areas supplying water to the SWP (source areas) is represented at the current level of use in the 2001 study and at a level projected to occur 20 years in the future for the 2021 studies. The demand of the SWP contractors is at its current level for the 2001 study and is projected to increase to be very near or at the maximum level in the 2021 studies.

The 2021 studies differ in only one respect. In one study, the SWP demand varies each year with the weather in the delivery areas (2021A). In the other study, the SWP demand is maximized each year, regardless of weather (2021B). Table 1 summarizes these key assumptions. There are two types of deliveries assumed for the SWP contractors: Table A and Article 21. Article 21 deliveries are available on an unscheduled and interruptible basis and are not counted as part of the Table A amount. (See Page 11 for more discussion of Article 21.)

Selecting and quantifying the assumptions and factors comprise just the first step in the analysis. The next step involves fitting them together and

Table 1 Key study assumptions

Common assumptions

	Existing facilities and operation requirements	Environmental Water Account included

Study-specific assumptions

Study	*Use of water in source areas*	*SWP contractors' demands from the Delta*
Study 2001	2001 level of development	Table A demand: 3.0-4.1 maf/yr, weather variable Article 21 demand: Up to 84 taf/mo
Study 2021A	2020 level of development[1]	Table A demand: 3.3-4.1 maf/yr, weather variable Article 21 demand: Up to 84 taf/mo, Apr-Nov Up to 134 taf/mo, Dec-Mar
Study 2021B	2020 level of development[1]	Table A demand: 4.1 maf/yr Article 21 demand: Same as Study 2021A

[1] Assumed sufficient for 2021
taf=thousand acre-feet

describing or predicting how they interact to affect the ability of the SWP to make water deliveries.

Fitting the Assumptions and Factors Together: Models

The best tools available for fitting the assumptions and factors together to predict SWP water deliveries are the computer simulation models that DWR and the U.S. Bureau of Reclamation have developed over the years for their various water planning purposes. The most recent of these models is a combined State and federal model called CALSIM.

CALSIM simulates the operations of the SWP and Central Valley Project (CVP) under various assumed hydrologic conditions, regulations, and facility configurations to estimate water deliveries to SWP and CVP water users.

The Usefulness of the CALSIM Model

CALSIM and its predecessor models can be used in two ways. The first is in the comparative mode and the other is in the stand-alone mode. The comparative mode consists of comparing two model runs—one that contains a proposed action and one that does not. The proposed action could be the addition of a new reservoir or changes in operation regulations. Differences in certain factors, such as deliveries or reservoir storage levels, are analyzed to determine the effect of the proposed action. The model assumptions are less significant in a comparative study than a stand-alone study because all of the assumptions are the same for both the "with-action" and "without-action" model runs, except the action itself, and the focus of the analysis is the differences in the results.

In the stand-alone mode, the results of one model run, such as the amount of delivery or reservoir levels, are analyzed directly. The only information available to compare with the results is historical information that, for the reasons discussed earlier, is not directly comparable. The assumptions for a stand-alone study are, therefore, very significant. The SWP delivery reliability estimates use stand-alone computer model studies.

DWR is constantly working to improve the accuracy and usefulness of CALSIM, particularly the information and assumptions put into the model and the way in which that input is processed. Model study results and assumptions are critiqued by an interagency/stakeholder group and are available via DWR's modeling Web site, http://modeling.water.ca.gov/. DWR's models are also reviewed and discussed at the California Water and Environmental Modeling Forum (formerly the Bay-Delta Modeling Forum), a statewide organization dedicated to increasing the usefulness of computer models for analyzing California's water-related problems with emphasis in the Central Valley, Delta, and Bay. More information about the Modeling Forum is on its Web site, http://www.cwemf.org/.

Even though CALSIM provides a very comprehensive "picture" of the water delivery reliability of the SWP, it necessarily makes simplifying assumptions and relies on data input that is less than perfect. On the other hand, the complexity of assumptions and factors that must enter into any reasonable determination of delivery reliability must be considered and dealt with somehow. CALSIM is by far the best tool available for that purpose. The current version, CALSIM II, was used for the studies contained in this report.

Results of the studies contained in this report differ from results of studies using earlier versions of CALSIM. For example, the average water delivery reliability of the SWP estimated for study 2021A in this report is 75 percent of full Table A. An earlier study released by DWR estimated an average water delivery of 80 percent[1]. One of the primary reasons for this difference relates to the method used to calculate the amount of flow from the Sacramento-San Joaquin Delta necessary to maintain the water quality standards of the Delta. The method used for this report calculates more outflow is needed to maintain Delta water quality, and, therefore, less water is available for SWP deliveries. The technical staff of DWR believes the new method more accurately estimates Delta outflow requirements. Staff has modified CALSIM accordingly. Another reason for the difference is improvement of CALSIM's hydrology. Technical staff from DWR and U.S. Bureau of Reclamation have worked together over the past year and has successfully developed hydrology that both agencies have approved. CALSIM II includes this improved hydrology.

[1] Model study 2020D09E-ISDP-964 conducted by the California Department of Water Resources.

DWR will continue to investigate the accuracy of CALSIM II for forecasting water delivery reliability and its sensitivity to the assumptions incorporated into the studies. This investigation is also important to the development of Bulletin 160 and the analysis of storage and conveyance projects proposed under the CALFED Program. Over the next year, DWR will conduct two exercises in this regard. One exercise will analyze how well CALSIM II can simulate the water project deliveries for a recent historical period. The second exercise will be a series of studies of the changes in SWP deliveries produced by varying specific assumptions of the model's input. For example, the effect of a large increase in water use in the source areas upon SWP deliveries could be evaluated. Reports of the results of these exercises will be made available to the public when they are completed.

III
Study Results

The annual amounts of SWP deliveries estimated by CALSIM II are listed in tables B-3, B-4, and B-5 of Appendix B. This chapter contains tables summarizing the estimated delivery amounts for the entire study period, dry years, and wet years and presents information on the estimated probability of SWP delivery amounts.

Article 21 Deliveries

The studies estimate delivery amounts for Table A and Article 21. As mentioned earlier, Table A is the contractual method for allocating available supply, and the total of all maximum Table A amounts for deliveries from the Delta is 4.133 maf per year. Article 21 refers to a provision in the contract for delivering water that is available in addition to Table A amounts. (See Appendices C and D for more discussion.) Article 21 of SWP contracts allows contractors to receive additional water deliveries only under specific conditions. These conditions are:

1) It is available only when it does not interfere with SWP allocations;
2) It is available only when excess water is available in the Delta;
3) It is available only when conveyance capacity is not being used for SWP purposes or scheduled SWP deliveries; and
4) It cannot be stored within the SWP system. In other words, the contractors must be able to use the Article 21 water directly or store it in their own system.

Water supply under Article 21 becomes available only during wet months of the year, generally December through March. Because an SWP contractor must have an immediate use for Article 21 supply or a place to store it outside of the SWP, not all SWP contractors can take advantage of this additional supply.

Its importance to local water supply is tied to how each contractor uses its SWP supply. For those SWP contractors who are able to store their wet weather supplies, Article 21 can be stored by being put directly into a reservoir or by offsetting other water that would have been withdrawn from storage, such as local groundwater. In the absence of storage, Article 21 water is not likely to contribute significantly to local water supply reliability. Incorporating supplies received under Article 21 into the assessment of water supply reliability is a local decision based on specific local circumstances, facts, and level of water supply reliability required.

This report presents information on Article 21 water separately so local agencies can choose whether it is appropriate to incorporate this supply in their analyses.

SWP Water Deliveries under Different Hydrologic Scenarios

The results of the studies estimating SWP water deliveries under current conditions (2001) and 2021 conditions are summarized in tables 2, 3, and 4.

Average, Maximum, and Minimum

Table 2 contains the average, maximum, and minimum values for studies 2001, 2021A, and 2021B. Comparing the results for 2001 and 2021A (weather variable demand) shows the average Table A delivery value is projected to increase by only 3 percent points, from 72 percent to 75 percent over the next 20 years. When it is assumed the demand for 2021 will not vary with the weather and will be constant at 4.13 maf (2021B study), the average Table A delivery value is 76 percent, only 1 percent point above the 2021A study. These relatively small differences indicate that the SWP Table A demand is very near the full Table A amount. Recall that the delivery levels range from 3.0 maf per year to 4.1 maf per year for the 2001 study; from 3.3 maf per year to 4.1 maf per year for the 2021A study; and is constant at 4.1 maf per year for the 2021B study.

Notice the average amount of water supply per year under Article 21 decreases from 130 thousand acre-feet (taf) in study 2001 to 80 taf in study

Table 2 SWP Table A and Article 21 deliveries from the Delta

Study	*Average*	*Maximum*	*Minimum*
2001 study			
Table A	2,960 taf (72%)	3,850 taf (93%)	800 taf (19%)
Article 21	130 taf	510 taf	0
2021A study			
Table A	3,080 (75%)	4,130 taf (100%)	830 taf (20%)
Article 21	80 taf	400 taf	0
2021B study			
Table A	3,130 (76%)	4,130 taf (100%)	830 taf (20%)
Article 21	70 taf	400 taf	0

Percent of Table A in parentheses.

Table 3 SWP Delta average and dry-year Table A deliveries (in percent of full Table A[1])

	Average	*Single dry year 1977*	*2-year drought 1976-1977*	*4-year drought 1931-1934*	*6-year drought 1987-1992*	*6-year drought 1929-1934*
2001	72	19	48	37	41	40
2006	73	19	47	38	41	40
2011	74	20	46	38	41	41
2016	74	20	45	39	40	41
2021	75	20	44	39	40	41

[1]Full Table A = 4.133 maf per year

2021A. Water pumped from the Delta will go toward meeting Table A demands prior to being made available under Article 21. The 50 taf decrease is a direct result of the assumed increase in Table A demand for the 2021A study. Study 2021B reflects this same relationship with an average Article 21 delivery of 70 taf, slightly less than study 2021A.

Drought Years

Table 3 includes estimates of water deliveries under an assumed repetition of historical drought periods. The years are identified as dry by the Eight River Index, a good indicator of the relative amount of water supply available to the SWP. The Eight River Index is the sum of the unimpaired runoff from the four rivers in the Sacramento Basin used to define water conditions in the basin plus the four rivers in the San Joaquin Basin, which correspondingly define water conditions in that basin. The eight rivers are the Sacramento, Feather, Yuba, American, Stanislaus, Tuolumne, Merced, and San Joaquin. Table 3 also includes the average deliveries for comparison purposes. These values are shown for 5-year intervals as required by SB 610. The intermediate estimates are simply linearly interpolated from the study results for 2001 and 2021. The results for the two studies for 2021 are essentially the same for these drought periods.

Even though the demands are projected to increase from 2001 to 2021 and the resulting amount of reservoir carryover storage is less, the drought deliveries are estimated to remain about the same (see Table 3). This result is attributable to the operation rules governing the amount of water that must be retained for carryover storage, the fact that SWP demand between 2001 and 2021 increases relatively slightly, and because less water is made available under Article 21.

Table 4 summarizes the estimates of deliveries under Article 21. Notice the reductions for study year 2021 for the 2-year, 4-year, and 6-year droughts. This reduction is due to the increase in Table A deliveries.

Table 4 Water supply under Article 21 (taf per year; year of delivery in parentheses)

Study	*Average*	*Single dry year 1977*	*2-year drought 1976-1977*	*4-year drought 1931-1934*	*6-year drought 1987-1992*	*6-year drought 1929-1934*
2001	130	0	110 (1976)	0 (1931)	0	0 (1929)
				200 (1932)		90 (1930)
				130 (1933)		0 (1931)
				0 (1934)		200 (1932)
						130 (1933)
						0 (1934)
2021	80	0	0	0 (1931)	0	0 (1929)
(A and B)				40 (1932)		30 (1930)
				10 (1933)		0 (1931)
				0 (1934)		40 (1932)
						10 (1933)
						0 (1934)

Numbers rounded to nearest 10,000 acre-feet

Table 5 SWP Delta average and wet-year delivery (in percent of full Table A)

Study	*Average*	*Single wet year 1983*	*2-year wet 1982-1983*	*4-year wet 1980-1983*	*6-year wet 1978-1983*	*10-year wet 1978-1987*
2001	72	73	79	80	80	80
2021A	75	82	89	86	87	84
2021B	76	100	100	91	91	87

Wet Years

The following two tables summarize the model run results for historical wet years. As with drought years, the Eight River Index is used to identify the wet years.

Table 5 illustrates the effect of the demand assumption upon Table A deliveries. The SWP demand assumed in the 2001 study is less than the projected demand of the 2021A study; and the projected demand of the 2021A study is less than the 2021B study. Because plenty of water is available for deliveries, the less the demand, the less the Table A delivery amounts. The single wettest year (1983) provides a good example. In 1983, the Table A deliveries in study 2021A, which assumes a weather-variable demand, are estimated to be 9 percentage points greater than the study for 2001 (82 percent vs. 73 percent). Study 2021B, which assumes a higher demand (non-variable maximum demand), results in 100 percent of Table A delivery for the same year. This relationship is repeated for each wet period.

Historically, the level of demand under wet conditions in the Central Valley and Southern California is usually lower than under dry conditions. This is because irrigation and landscape demand in the local area is being met by rainfall and local runoff is helping to fill local storage facilities. Study 2021A estimates Table A deliveries when SWP service area demand varies with the weather. The historical weather-variable pattern may change as additional storage is developd in local areas (such as Diamond Valley reservoir in Southern California).

Table 6 Average wet-year water supply under Article 21
(taf per year; year of delivery in parentheses)

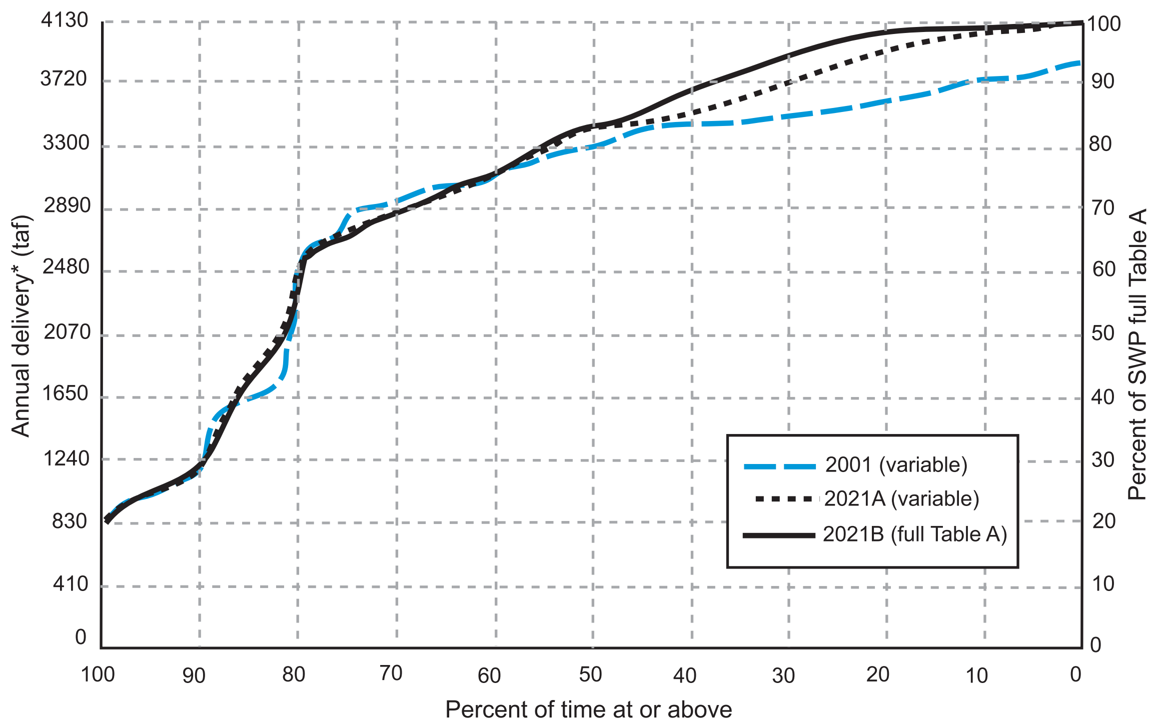
Study	*Average*	*Single wet year 1983*	*2-year wet 1982-1983*	*4-year wet 1980-1983*	*6-year wet 1978-1983*	*10-year wet 1978-1987*
2001	130	200	390 (1982)	100 (1980)	100 (1978)	100 (1978)
			200 (1983)	120 (1981)	140 (1979)	140 (1979)
				390 (1982)	100 (1980)	100 (1980)
				200 (1983)	120 (1981)	120 (1981)
					390 (1982)	390 (1982)
					200 (1983)	200 (1983)
						410 (1984)
						0 (1985)
						50 (1986)
						0 (1987)
2021A	80	200	100 (1982)	70 (1980)	100 (1978)	100 (1978)
			200 (1983)	0 (1981)	90 (1979)	90 (1979)
				100 (1982)	70 (1980)	70 (1980)
				200 (1983)	0 (1981)	0 (1981)
					100 (1982)	100 (1982)
					200 (1983)	200 (1983)
						380 (1984)
						0 (1985)
						50 (1986)
						0 (1987)
2021B	80	160	60 (1982)	80 (1980)	100 (1978)	100 (1978)
			160 (1983)	0 (1981)	100 (1979)	100 (1979)
				60 (1982)	80 (1980)	80 (1980)
				160 (1983)	0 (1981)	0 (1981)
					60 (1982)	60 (1982)
					160 (1983)	160 (1983)
						370 (1984)
						0 (1985)
						60 (1986)
						0 (1987)

Numbers rounded to nearest 10,000 acre-feet

The results of study 2021B can be helpful to water district and agency planners in estimating the additional supply available under Table A if additional local facilities were built to store the water.

As a final note on Table 5, the average amount of annual Table A deliveries estimated under study 2021B decrease as the wet period lengthens. This is because the projected demands in study 2021B are fixed at 4.133 maf per year and the average amount of water available per year to the SWP is less in the longer wet periods than the shorter ones. This pattern is not exhibited as well in study 2021A or at all in study 2001 because the annual demands are assumed to be lower during wet years.

Table 6 contains information about Article 21 deliveries for the same wet-year periods. The



* Annual delivery rounded to nearest 10,000 acre-feet

Figure 1 SWP Delta delivery probability (Table A)

information illustrates a significant decrease in the availability of Article 21 supply between 2001 and 2021. This is primarily due to the increase in Table A demand. Notice the corresponding increases between 2001 and 2021 for Table A amounts in Table 5 for the same periods.

SWP Table A Delivery Probability

The probability that a given level of SWP Table A amount will be delivered from the Delta is shown for the three studies in Figure 1. The plot lines in the figure are derived from the study results listed in tables B-3, B-4, and B-5 in Appendix B. Each line is constructed by ranking the 73 annual Table A delivery values of the relevant study from lowest to highest and calculating the percentage of values equal to or greater than the delivery value of interest. For example, for the 2021 studies, the value of 3.43 maf is in the middle of the ranking; therefore, it is equaled or exceeded by half of the 73 delivery values. The delivery value of 0.83 maf, the minimum value for the 2021 studies, is equaled or exceeded by all of the delivery values. The curves have been smoothed to slightly assist with their analysis.

The curves for the 2021 studies are very similar for the lower portion of the ranking (that is, delivery values equaled or exceeded by 50 percent to 100 percent of the values). These lower values are similar because deliveries are limited by the amount of water available to the SWP for export from the Delta. The curve for the 2001 study shows the same characteristic with slight variation. The curves diverge within the upper range of the delivery values.

A comparison of the upper range of the studies for 2021 illustrates the effect the projected demand has upon SWP deliveries. The deliveries in study 2021B reach 100 percent more frequently than in study 2021A (weather-variable demand) because the demand for 100 percent of Table A deliveries is assumed for each year of study 2021B. In study 2021A, the demand for 100 percent of Table A occurs in significantly fewer years and is rarely met because when 100 percent is assumed to be needed, the water year often cannot provide it. The delivery values in study 2001 never reach 100 percent Table A for the same reason.

The amount of SWP Table A delivery per year, either in percent of full Table A or in thousand acre-feet, associated with a specific degree of reliability can be determined from Figure 1. By referencing the curve for study 2021A or 2021B, the following can be deduced:

- In 75 percent of the years, the annual water delivery of the SWP is estimated to be at or above 2.70 maf/yr (66 percent of 4.13 maf);
- In 50 percent of the years, it is estimated to be at or above 3.40 maf/yr (83 percent of 4.13 maf); and
- In 10 percent of the years, it is at or greater than 4.10 maf/yr (98 percent of 4.13 maf).

Figure 1 depicts the estimated reliability for the total of SWP deliveries. This information can be directly applied to individual long-term water supply contracts for the SWP. For example, if a water agency has a full SWP Table A amount of 300 taf, it can expect to receive at least 200 taf per year (66 percent of 300 taf) 75 percent of the time. The individual curves for studies 2001, 2021A, and 2021B are in Appendix B.

Additional Analysis of Tables B-3, B-4, and B-5 in Appendix B

The above information can be helpful in analyzing the delivery reliability of a specific water system receiving a portion of its water supply from the SWP. The series of data contained in tables B-3, B-4, and B-5 are also very helpful in analyzing longer periods of time that contain not only dry periods but wetter periods, which can replenish local water supplies if there is a place to store the supply. Analysis of this information can help determine if a local agency has adequate storage for capturing these supplies or if more storage could be utilized in the local water system.

IV
The Reliability of Local Water Supplies

The real significance of SWP water delivery reliability is not to the SWP itself but to the agency that ultimately provides the SWP water to its municipal, industrial, and agricultural customers and to the city or county that makes the land-use decisions in which water supply is a matter of key concern. SWP water delivery reliability is most important as it affects the local provider's overall water supply reliability.

This report does not recommend a particular level of SWP water delivery reliability for any individual SWP water contractor. The degree of reliability of SWP water deliveries that a local water provider desires or needs depends on the particular facts and circumstances that pertain to that provider. For example, if periodic shortages can be tolerated, then a lesser degree of SWP reliability will be "reliable enough." If, on the other hand, water is needed every year, say, for permanent crops like orchards and vineyards, and no replacement supply is available, higher SWP water delivery reliability will be desired.

Local water delivery reliability depends not only on SWP supplies but upon all sources of supply to the local provider. For example, the local provider may have access to local surface water and groundwater supplies, to reclaimed water, or to other sources of imported water, which have different levels of reliability. If so, the local provider will manage all sources of supply together, each with its individual degree of reliability, to enhance overall reliability. It is also at the local level that demand itself may be managed to meet supply, through conservation, water use efficiency, drought response planning, and land-use planning decisions made by local jurisdictions.

Two examples of fictional agencies are provided below to help illustrate how the information provided in this report may assist local water supply planners. A third example shows how the information must be carefully analyzed to avoid misinterpretation.

Greenacres Irrigation District

Greenacres Irrigation District provides water to a farming area in the Central Valley. The demand for water for uses other than irrigation is negligible. The district has two sources of water—surface water from the SWP and up to 110 taf per year of groundwater pumped from district-owned wells. Most of the water demand is for perennial crops (orchards and grapevines). The remaining is for annual field crops such as tomatoes and corn. The district's contract with the SWP is for a maximum Table A amount of 300 taf.

The district's water system can convey the full Table A amount if it is available, but there is no ability to store any unused supply. The cost of pumping groundwater is higher per acre-foot than the SWP supply; therefore, the district will maximize its use of SWP water. The average annual demand for the district is 300 taf. The district must deliver 180 taf annually to assure none of the trees and vines are lost. If conditions were extremely dry, permanent crops would have priority for the limited water supply. District managers are interested in analyzing a range of possible water supplies to assess the impact upon the district.

One item of interest is the probability of the district receiving at least 180 taf from the SWP now and in the future. These probabilities can be derived by using Figure 2. Figure 2 is the same as Figure 1 except Greenacres Irrigation District Table A amount is shown on the left axis.

The minimum target for SWP deliveries for the district is 180 taf per year, or 60 percent of its maximum Table A amount. Figure 2 provides the district's current probability of receiving at least 180 taf per year from the SWP. It shows the district

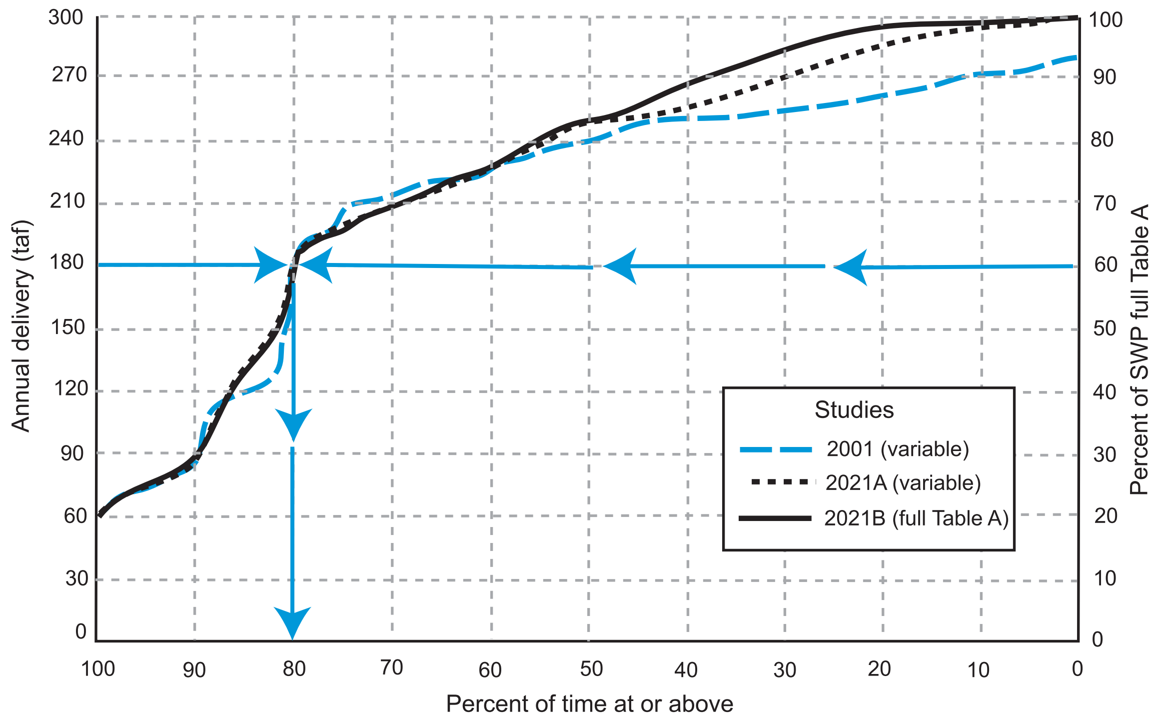


Figure 2 Greenacres Irrigation District delivery probability (Table A)

has an 80 percent chance of receiving at least 60 percent of Table A in any given year under all three study scenarios.

The district would like a better chance of assuring its minimum needs will be met and will use groundwater to make up the difference. From Figure 2, it is determined that SWP Table A deliveries of about 30 percent can be made or exceeded 90 percent of the time. The district can, therefore, expect to receive at least 90 taf in 9 out of 10 years. This indicates that 90 taf will need to come from groundwater to assure minimum needs (180 taf) are met. The district can meet this amount of groundwater need.

The district can deliver up to 110 taf of groundwater in a particularly dry year. To meet its minimum need of 180 taf, 70 taf would be required from the SWP. The probability of the SWP providing that amount of Table A delivery is 98 percent (Figure 2, value corresponding to 23 percent of maximum Table A).

Finally and to help with long-term planning, the district would like to estimate the average amount of annual groundwater pumping. Figures 1 or 2 cannot be used for this analysis. Figure 1 can provide the percent of full Table A exceeded 50 percent of the time. This value is called the median value. The average value and median value are not the same. Table 2 (see Page 11) contains the average Table A values. The average Table A delivery is estimated to be 72 percent in 2001 and 75 percent in 2021. These values indicate the district will receive an average Table A delivery from the SWP of 220 taf per year in 2001 and 230 taf per year in 2021. Correspondingly, groundwater pumping will average 80 taf per year in 2001 and 70 taf per year in 2021.

More detailed analyses can be done using the information contained in tables B-3, B-4, and B-5 in Appendix B. For example, the district may wish to analyze the drought periods to determine whether the groundwater system will be able to meet the district's water needs if these periods were repeated.

The analyses for Greenacres Irrigation District focus on the dry periods because the district has no ability to store water during wet periods. This is not the case in the following example.

Southcity Water Agency

Southcity Water Agency serves a major metropolitan area with many high-technology industries. The water agency has several sources of water, including the SWP. Because of the high drinking water demands and the needs of the local industries, the quality of its water supply is very important to the agency.

The quality of water from the SWP is much better than most other sources of supply, so Southcity maximizes its use of Table A deliveries. It also receives a portion of its supply as deliveries under Article 21 when they are available. The district is interested in how its supply under Article 21 is projected to change over time.

Table 2 contains the estimated values for Article 21 supplies. The average and maximum deliveries are projected to decrease over time, even though the demand for Article 21 water is projected to increase. This is due to the increase in demand for Table A amounts. The district's projected Article 21 demands are included in the estimated demand of 84 taf per month contained in 2001 computer study. The district's amount of the estimated Article 21 demand for 2001 is 20 taf per month, or about 24 percent.

Table 2 indicates the district's amount of Article 21 deliveries will decrease over the 20-year period. For example, the maximum Article 21 delivery for 2001 is 510 taf per year. In this study, the demand is 84 taf per month. Assuming the district can take all its delivery, the district would receive 24 percent of 510 taf, or 120 taf, that year.

In both of the 2021 studies, the maximum Article 21 delivery is 400 taf per year. The district's portion of the Article 21 demand has dropped, however, because an additional demand of 50 taf per month for December through March is assumed. Due to the increased demand under Table A, the amount of Article 21 deliveries are less and the period of time they are available is shortened. In the 2021 studies, it is reasonable to assume Article 21 deliveries occur only during the December through March period. The estimated demand for Article 21 deliveries during that period is 134 taf per month for the 2021 studies. The district's portion of the Article 21 delivery is reduced from 24 percent to 15 percent (20/134). Therefore, the maximum the district can expect to receive at the assumed level of demand for 2021 is 15 percent of 400 taf, or 60 taf.

This cursory analysis indicates that, with no changes in its operation for Article 21 supply, the district's opportunity to receive this supply is projected to decrease over time. Further analysis would be necessary to explore specific operational changes or additional facilities the district would consider to maintain or improve its ability to receive Article 21 water.

Small Pipe Irrigation District

Small Pipe Irrigation District's sole water provider is the SWP. Small Pipe ID's contract with the SWP is for 300 taf per year; however, the water system for the district can convey a maximum of only 150 taf per year. Because of the limitation in the ability to receive deliveries, the results presented in this report do not apply directly to the district.

For example, 150 taf per year is 50 percent of the maximum Table A amount in the district's contract. Table B-3 contains 73 annual estimates for Table A deliveries. Out of these 73 values, 59 are greater than 50 percent. The average Table A delivery to Small Pipe ID is calculated by replacing any value greater than 50 percent in the table with 50 percent, summing up the new list of values, and dividing by 73. For Small Pipe ID, the average delivery for 2001 is estimated to be 46 percent of its maximum Table A amount, not 72 percent as shown in Table B-3 or Table 2. In addition, the probability curves will be different for the district, as well as the maximum delivery amounts. An obvious example is that Small Pipe ID's maximum delivery will be 50 percent of full Table A, not the estimated values shown in Table 5.

This example is to alert readers to the potential for misinterpretation of the information contained in this report. Questions regarding the use of this information may be directed to the Department of Water Resources at the address on the following page.

V
Conclusion

Appendices A and B contain the detailed results of the CALSIM II analyses of SWP water delivery and the specific assumptions of the studies. Much more information on DWR's modeling effort and these particular studies is available at DWR's Web site, http://modeling.water.ca.gov/.

This report is a draft currently under public review. Once final, the Department will update the water delivery analyses every two years or more frequently if study factors change or analytical tools improve significantly.

For additional information or assistance regarding the reliability of SWP water deliveries and the assumptions regarding demands, operations, and supply, please write to:

Attention: SWP Water Delivery Report
California Department of Water Resources
P. O. Box 942836
Sacramento, California 94236-0001

Appendix A
CALSIM II Model Assumptions for 2001 and 2021 Studies

	2001 Study BST_2001D10A-ANNBENCHMARK_1_1	2021A Study BST_2020D09D-ANNBENCHMARK_2_1	2021B Study BST_2020D09D-SWPTABLEA_5_1
Period of Simulation	73 years (1922-1994)	Same	Same
	HYDROLOGY		
Level of Development (Land Use)	2001 Level, DWR Bulletin 160-98[a]	2020 Level, DWR Bulletin 160-98	Same
DEMANDS			
North of Delta (exc American R)			
CVP	Land Use based, limited by Full Contract	Same	Same
SWP (FRSA)	Land Use based, limited by Full Contract	Same	Same
Non-Project	Land Use based	Same	Same
CVP Refuges	Firm Level 2	Same	Same
American River Basin			
Water rights	2001[b]	2020, Sacramento Water Forum[c]	Same
CVP	2001[b]	2020, Sacramento Water Forum[c] and EBMUD[d]	Same
San Joaquin River Basin			
Friant Unit	Regression of historical	Same	Same
Lower Basin	Fixed annual demands (source unknown)	Same	Same
Stanislaus River Basin	New Melones Interim Operations Plan	Same	Same
South of Delta			
CVP	Full Contract	Same	Same
CCWD	140 TAF/YR[e]	195 TAF/YR[e]	Same
SWP (w/North Bay Aqueduct)	3.0-4.1 MAF/YR	3.3-4.1 MAF/YR	4.1 MAF/YR
Article 21 Demand	Up to 84 TAF/month	Up to 134 TAF/month, Dec-Mar, others up to 84 TAF/month	Same

	2001 Study BST_2001D10A-ANNBENCHMARK_1_1	2021A Study BST_2020D09D-ANNBENCHMARK_2_1	2021B Study BST_2020D09D-SWPTABLEA_5_1
FACILITIES			
	Existing Facilities (2001)	Same	Same

REGULATORY STANDARDS

Trinity River			
Minimum Flow below Lewiston Dam	Trinity EIS Preferred Alternative (369-815 TAF/YR)	Same	Same
Trinity Reservoir End-of-September Minimum Storage	Trinity EIS Preferred Alternative (600 TAF as able)	Same	Same
Clear Creek			
Minimum Flow below Whiskeytown Dam	Downstream water rights, 1963 USBR Proposal to USFWS and NPS, and USFWS discretionary use of CVPIA 3406(b)(2)	Same	Same
Upper Sacramento River			
Shasta Lake End-of-September Minimum Storage	SWRCB WR 1993 Winter-run Biological Opinion (1900 TAF)	Same	Same
Minimum Flow below Keswick Dam	Flows for SWRCB WR 90-5 and 1993 Winter-run Biological Opinion temperature control, and USFWS discretionary use of CVPIA 3406(b)(2)	Same	Same
*Feather River_*			
Minimum Flow below Thermalito Diversion Dam	1983 DWR, DFG Agreement (600 CFS)	Same	Same
Minimum Flow below Thermalito Afterbay outlet_	1983 DWR, DFG Agreement (1,000 – 1,700 CFS)	Same	Same
American River			
Minimum Flow below Nimbus Dam	SWRCB D-893 (see accompanying Operations Criteria), and USFWS discretionary use of CVPIA 3406(b)(2)	Same	Same
Minimum Flow at H Street Bridge	SWRCB D-893	Same	Same
Lower Sacramento River			
Minimum Flow near Rio Vista	SWRCB D-1641	Same	Same
Mokelumne River			
Minimum Flow below Camanche Dam_	FERC 2916-029, 1996 (Joint Settlement Agreement) (100 – 325 CFS)	Same	Same
Minimum Flow below Woodbridge Diversion Dam_	FERC 2916-029, 1996 (Joint Settlement Agreement) (25 – 300 CFS)	Same	Same

	2001 Study BST_2001D10A-ANNBENCHMARK_1_1	2021A Study BST_2020D09D-ANNBENCHMARK_2_1	2021B Study BST_2020D09D-SWPTABLEA_5_1
Stanislaus River			
Minimum Flow below Goodwin Dam	1987 USBR, DFG agreement, and USFWS discretionary use of CVPIA 3406(b)(2)	Same	Same
Minimum Dissolved Oxygen	SWRCB D-1422	Same	Same
Merced River			
Minimum Flow below Crocker-Huffman Diversion Dam_	Davis-Grunsky (180 – 220 CFS, Nov – Mar), and Cowell Agreement	Same	Same
Minimum Flow at Shaffer Bridge_	FERC 2179 (25 – 100 CFS)	Same	Same
Tuolumne River			
Minimum Flow at Lagrange Bridge_	FERC 2299-024, 1995 (Settlement Agreement) (94 – 301 TAF/YR)	Same	Same
San Joaquin River			
Maximum Salinity near Vernalis	SWRCB D-1641	Same	Same
Minimum Flow near Vernalis	SWRCB D-1641, and Vernalis Adaptive Management Program per San Joaquin River Agreement	Same	Same
Sacramento River-San Joaquin River Delta			
Delta Outflow Index (Flow and Salinity)	SWRCB D-1641	Same	Same
Delta Cross Channel Gate Operation	SWRCB D-1641	Same	Same
Delta Exports	SWRCB D-1641, USFWS discretionary use of CVPIA 3406(b)(2), and CALFED Fisheries Agencies discretionary use of EWA	Same	Same
OPERATIONS CRITERIA			
SUBSYSTEM			
Upper Sacramento River			
Flow Objective for Navigation (Wilkins Slough)	Discretionary 3,500 – 5,000 CFS based on Lake Shasta storage condition	Same	Same
American River			
Folsom Dam Flood Control	SAFCA, Interim-Reoperation of Folsom Dam, Variable 400/670 (without outlet modifications)	Same	Same
Flow below Nimbus Dam	Discretionary operations criteria corresponding to SWRCB D-893 required minimum flow	Same	Same

	2001 Study BST_2001D10A-ANNBENCHMARK_1_1	2021A Study BST_2020D09D-ANNBENCHMARK_2_1	2021B Study BST_2020D09D-SWPTABLEA_5_1
Sacramento Water Forum Mitigation Water	None	Sacramento Water Forum (up to 47 TAF/YR in dry years)	Same
Stanislaus River			
Flow below Goodwin Dam	1997 New Melones Interim Operations Plan	Same	Same
San Joaquin River			
Flow near Vernalis	San Joaquin River Agreement in support of the Vernalis Adaptive Management Program	Same	Same
System-wide			
CVP Water Allocation			
CVP Settlement and Exchange	100% (75% in Shasta Critical years)	Same	Same
CVP Refuges	100% (75% in Shasta Critical years)	Same	Same
CVP Agriculture	100% - 0% based on supply (reduced by 3406(b)(2) allocation)	Same	Same
CVP Municipal & Industrial	100% - 50% based on supply (reduced by 3406(b)(2) allocation)	Same	Same
SWP Water Allocation			
North of Delta (FRSA)	Contract specific	Same	Same
South of Delta	Based on supply; Monterey Agreement	Same	Same
CVP/SWP Coordinated Operations			
Sharing of Responsibility for In-Basin-Use	1986 Coordinated Operations Agreement	Same	Same
Sharing of Surplus Flows	1986 Coordinated Operations Agreement	Same	Same
Sharing of Restricted Export Capacity	Equal sharing of export capacity under SWRCB D-1641; use of CVPIA 3406(b)(2) only restricts CVP exports; EWA use restricts CVP and/or SWP as directed by CALFED Fisheries Agencies	Same	Same
CVPIA 3406(b)(2)			
Allocation	800 TAF/YR (600 TAF/YR in Shasta Critical years)	Same	Same
Actions	AFRP flow objectives (Oct-Jan), CVP export reduction (Dec-Jan), 1995 WQCP (up to 450 TAF/YR), VAMP (Apr 15- May 16) CVP export restriction, Post (May 16-31) VAMP CVP export restriction, Ramping of CVP export (Jun), Pre (Apr 1-15) VAMP CVP export restriction, CVP export reduction (Feb-Mar), Additional Upstream Releases (Feb-Sep)	Same	Same

	2001 Study BST_2001D10A-ANNBENCHMARK_1_1	2021A Study BST_2020D09D-ANNBENCHMARK_2_1	2021B Study BST_2020D09D-SWPTABLEA_5_1
CALFED Environmental Water Account			
Actions	Total exports restricted to 4,000 CFS, 1 wk/mon, Dec-Mar (wet year: 2 wk/mon), VAMP (Apr 15- May 16) export restriction, Pre (Apr 1-15) and Post (May 16-31) VAMP export restriction, Ramping of export (Jun)	Same	Same
Assets	50% of use of JPOD, 50% of any CVPIA 3406(b)(2) or ERP releases pumped by SWP, flexing of Delta Export/Inflow Ratio (not explicitly modeled), dedicated 500 CFS increase of Jul – Sep Banks PP capacity, north-of-Delta (35 TAF/Yr) and south-of-Delta purchases (50 – 200 TAF/Yr), 100 TAF/Yr from south-of-Delta source shifting agreements, and 200 TAF/YR south-of-Delta groundwater storage capacity	Same	Same
Debt restrictions	No planned carryover of debt past Sep, no reset of unpaid debt, debt carried past Sep paid back by Feb	Same	Same

[a] 2000 Level of Development defined by linearly interpolated values from the 1995 Level of Development and 2020 Level of Development from DWR Bulletin 160-98
[b] 1998 Level Demands defined in Sacramento Water Forum's EIR with a few updated entries
[c] Sacramento Water Forum 2025 Level Demands defined in Sacramento Water Forum's EIR
[d] Freeport Alternative defined in EBMUD Supplemental Water Supply Project REIR/SEIS
[e] Delta diversions include Los Vaqueros Reservoir operations

Appendix B
Computer Simulation Models

A study to determine the supply reliability of the State Water Project is done using a computer program that simulates the operation of the SWP on a monthly basis over a 73-year historical record of rainfall and runoff (1922-1994). The simulation model integrates all the relevant water resource components and calculates key water management parameters, such as:

- the amount of water released from reservoirs in the Sacramento-San Joaquin valleys,
- the amount of water required to maintain Delta water quality standards,
- the amount of water to be pumped from the Delta by the SWP and the Central Valley Project (CVP), and
- the amount of water that can be delivered by each of these projects.

The information required to run the simulation is referred to as the "model input." The most significant categories of input are:

- the physical description of the water system facilities (maximum pumping or release capacity, maximum reservoir storages, etc);
- institutional requirements (delivery contract requirements, Delta water quality standards, the operations agreement between the SWP and CVP, endangered species requirements, and other requirements of federal and State laws, etc);
- hydrology (river and stream flows adjusted for water use in the source areas); and
- the level of SWP water demand.

CALSIM II

CALSIM II is the current version of the computer simulation model used to determine SWP delivery reliability. All versions of CALSIM employ commercially available linear programming software as a solution device. The application of the software, Graphical User Interface, and Input/Output devices is discussed in the documentation for CALSIM.[1]

The Study Assumptions

The studies done for this report answer two questions.

1) "What is the current delivery reliability of the SWP?" and
2) "What would the SWP be able to deliver in the year 2021, if there were no new facilities or improvements to existing facilities, SWP water demand increased, and the institutional requirements existing today were in place?"

Depending upon a person's expectation of what the future holds, this estimate of SWP delivery capability could be viewed as either too low or too high. The estimate could be viewed as too low because the Department is planning to have facilities in place by 2021 that will increase the reliability of the SWP. The estimate could be viewed as too high because the population of endangered Delta fish species could, for example, decline in the future and require the operation of the SWP to be more restricted than it is today.

Key Study Assumptions

The key study assumptions are listed in Table B-1. Additional discussion of these studies is on the DWR Modeling Branch's Web site (http://modeling.water.ca.gov/).

The Results

The annual delivery amounts calculated by the supply reliability studies are contained in tables B-3 (2001) and B-4 and B-5 (2021A and 2021B, respectively) at the back of this appendix. The tables show the demand level in thousand acre-feet (taf), the amount of delivery from the Delta, and percent of full Table A calculated for each year of simulation for the current condition (2001) and 2021.

[1] CALSIM documentation may be obtained through the DWR Modeling Branch's Web site: http://modeling.water.ca.gov.

Table B-1 Key assumptions used in calculating SWP water delivery reliability

	Level of development in source areas	*SWP facilities*	*Operation requirements*	*CALFED Environmental Water Account*	*SWP demand level from the Delta*
2001 Study	2001	Existing	1. SWP Banks export limit set at 6,680 cfs w/certain exemptions. 2. Delta water quality standards per 1995 Delta Water Quality Control Plan. 3. Operation coordinated with the CVP per the 1986 Coordinated Operations Agreement.	Included	3.0 - 4.1 maf, weather dependent
2021A Study	2020[1]	Same	1. Same 2. Same 3. Same	Same	3.3 - 4.1 maf, weather dependent
2021B Study	2020[1]	Same	1. Same 2. Same 3. Same	Same	4.1 maf, every year

CVP=Central Valley Project
maf=million acre-feet

[1] Assumed sufficient for 2021

Table B-2 SWP Delta dry-year delivery (percent of full Table A)

Year study	*Average*	*Single dry year 1977*	*2-year drought 1976-1977*	*4-year drought 1931-1934*	*6-year drought 1987-1992*	*6-year drought 1929-1934*
2001	72	19	48	37	41	40
2006	73	19	47	38	41	40
2011	74	20	46	38	41	41
2016	74	20	45	39	40	41
2021	75	20	44	39	40	41

These values must be interpreted within the confines of the assumptions upon which they are calculated. For example, for the year 1958, in the 2021A study, the annual delivery is calculated to be 3,910 taf or 95 percent of full Table A (see Table B-4). This result should be stated as follows:

> "If the rainfall were the same as it was in 1958 but (1) the level of water use in the source area was increased to the level it would be in 2021; (2) SWP facilities and operation requirements were the same as they are today; and (3) SWP contractor demands were very near their full Table A level, the SWP would deliver approximately 3,910 taf or 95 percent of full Table A."

Actually, the conditional statement associated with the result for any particular year is even more complicated than this because the result is also dependent upon the rainfall that has occurred in previous years. For example, if the previous year (1957) were wet, runoff for 1958 for the same amount of rainfall would be more than if 1957 were dry. In addition, reservoir storage for the beginning of 1958 would vary depending upon the weather conditions in 1957. This linkage makes each year's simulation dependent upon the previous year's and, hence, links the entire historical series.

Table B-2 contains a summary of the delivery estimates for the SWP for important dry periods in history computed by the studies. The five-year incremental values are linearly interpolated between

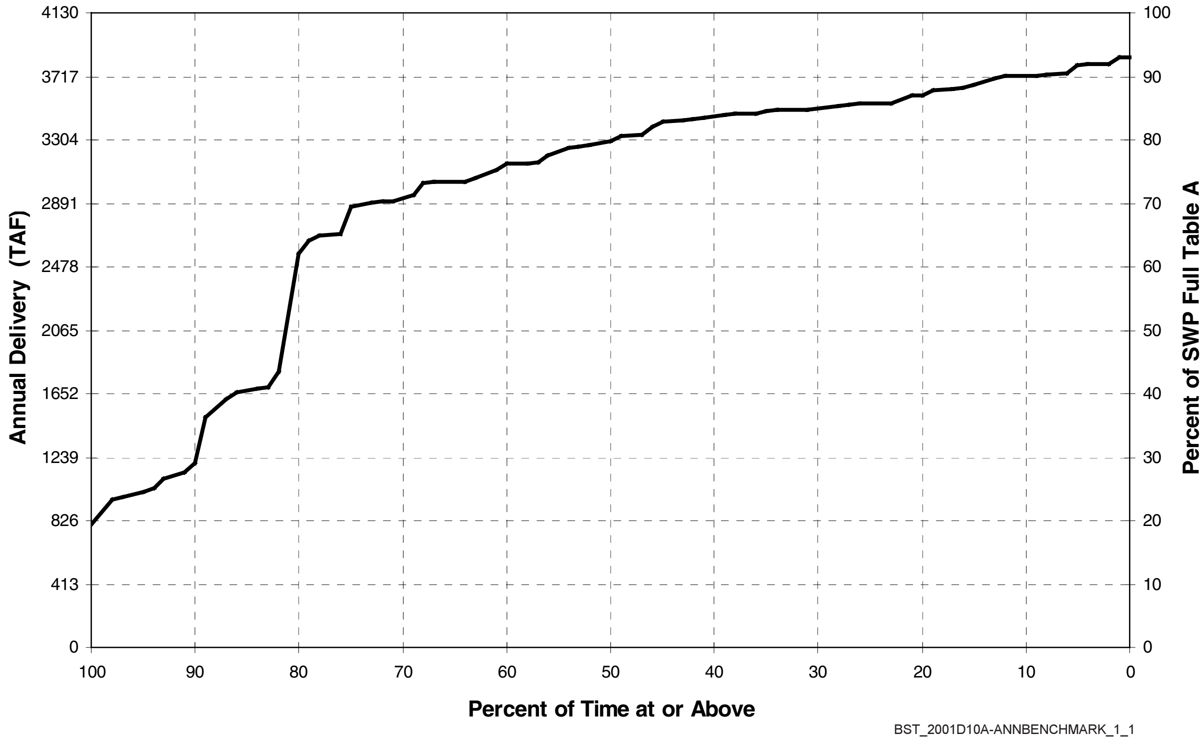


Figure B-1 Study 2001 SWP Delta delivery reliability

the 2001 and 2021A values. This information can be helpful in analyzing the delivery reliability of a specific water system that receives a portion of its water supply from the SWP. The series of data contained in tables B-3, B-4, and B-5 (see back of appendix) are also helpful in analyzing longer periods of time that contain not only dry periods but wetter periods, which can replenish water supplies.

Finally, to help analyze the chance of receiving a given level of delivery in any particular year, a probability distribution curve is useful. It simply shows the percent of the years the annual delivery estimate is at or above a given value. The probability distribution curves for 2001 and 2021 are included as figures B-1 (2001) and B-2 and B-3 (2021A and 2021B, respectively). For example, for the 2021A study (Figure B-2), the curve indicates that in 75 percent of the years, the annual delivery reliability is estimated to be at or above 66 percent of full Table A amounts or 2.73 maf. Similarly, annual delivery reliability during 50 percent of the years is estimated to be at or above 83 percent of full Table A or 3.43 maf. The curve also shows that in 10 percent of the years, annual delivery reliability is estimated to be greater than or equal to 98 percent of full Table A or 4.05 maf. A similar analysis can be done for the current condition using Figure B-1.

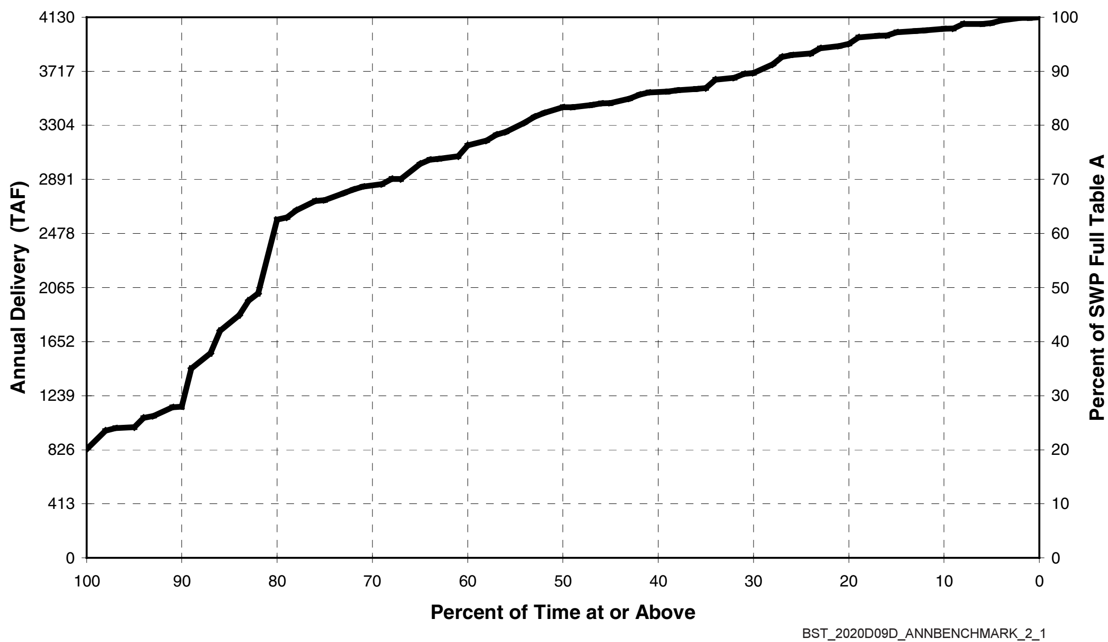


Figure B-2 Study 2021A SWP Delta delivery reliability

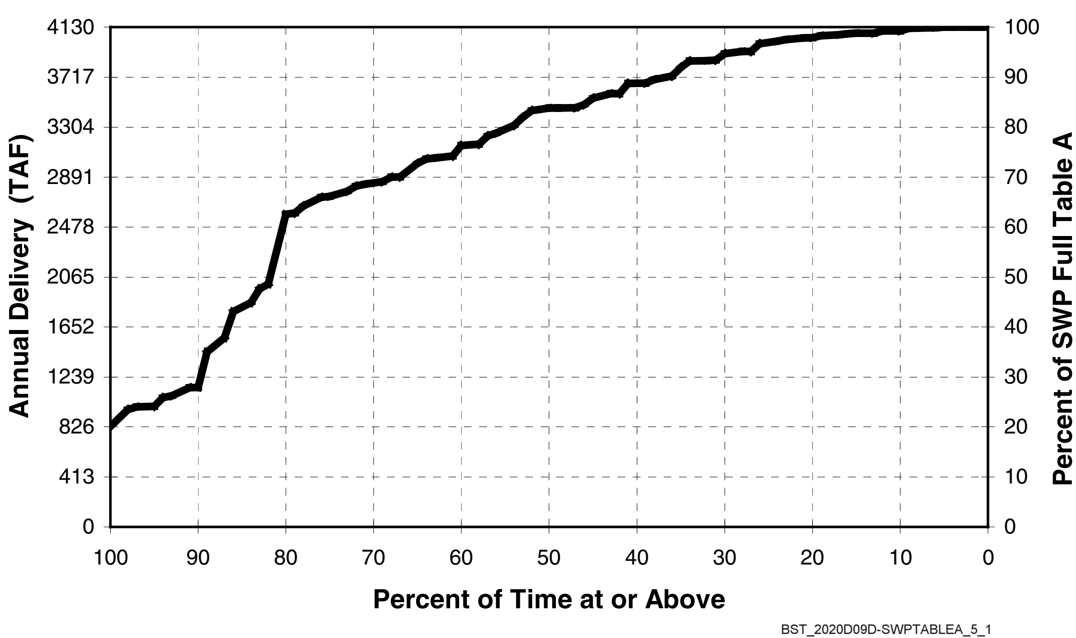


Figure B-3 Study 2021B SWP Delta delivery reliability

Table B-3 Study 2001 SWP Delta water delivery (taf)

Year	*Model Variable Demand*	*Model Delivery*	*Percent of Full Table A - 4.133 maf**	*Article 21 Supply*
1922	3407	3389	82	175
1923	3717	3727	90	143
1924	3961	1014	25	0
1925	3940	1502	36	0
1926	3777	2951	71	0
1927	3543	3504	85	220
1928	3897	3337	81	155
1929	3952	1037	25	0
1930	3922	2697	65	92
1931	3971	1141	28	0
1932	3673	1620	39	199
1933	3938	1663	40	134
1934	3981	1689	41	0
1935	3697	3439	83	81
1936	3769	3638	88	0
1937	3451	3297	80	87
1938	3418	3438	83	470
1939	3673	3475	84	227
1940	3713	3544	86	102
1941	3013	3036	73	100
1942	3583	3599	87	513
1943	3632	3545	86	447
1944	3563	3449	83	0
1945	3612	3479	84	136
1946	3710	3724	90	3
1947	3954	2652	64	0
1948	3959	2681	65	2
1949	3864	2568	62	2
1950	3812	2909	70	0
1951	3779	3794	92	311
1952	3078	3108	75	103

Table B-3 continued

Year	*Model Variable Demand*	*Model Delivery*	*Percent of Full Table A - 4.133 maf**	*Article 21 Supply*
1953	3790	3801	92	272
1954	3833	3803	92	98
1955	3761	1694	41	0
1956	3639	3649	88	261
1957	3759	3331	81	96
1958	3481	3492	84	441
1959	4055	3506	85	265
1960	4115	1795	43	0
1961	4115	2873	70	0
1962	3689	3158	76	21
1963	3634	3630	88	223
1964	3907	3262	79	5
1965	3586	3256	79	98
1966	3722	3731	90	147
1967	3439	3424	83	497
1968	3792	3548	86	402
1969	3157	3151	76	100
1970	3714	3727	90	406
1971	3837	3845	93	0
1972	4012	3057	74	2
1973	3611	3592	87	261
1974	3649	3664	89	297
1975	3720	3737	90	415
1976	4014	3150	76	110
1977	3948	804	19	0
1978	3126	3036	73	100
1979	3527	3509	85	140
1980	3197	3208	78	100
1981	3834	3532	85	124
1982	3451	3471	84	386
1983	3007	3036	73	200

Table B-3 continued

Year	*Model Variable Demand*	*Model Delivery*	*Percent of Full Table A - 4.133 maf**	*Article 21 Supply*
1984	3692	3706	90	408
1985	3753	3540	86	0
1986	3345	3023	73	51
1987	3904	2894	70	0
1988	4026	967	23	0
1989	4097	2902	70	0
1990	3961	1101	27	0
1991	3957	983	24	0
1992	3880	1199	29	0
1993	3559	3505	85	133
1994	3739	3272	79	9
Average	3712	2962	72	134
Maximum	4115	3845	93	513
Minimum	3007	804	19	0

Study: BST_2001D10A-ANNBENCHMARK_1_1
*4.133 maf per year is maximum Table A for deliveries from the Delta

Table B-4 Study 2021A SWP Delta water delivery (taf)

Year	*Model Variable Demand*	*Model Delivery*	*Percent of Full Table A - 4.133 maf**	*Article 21 Supply*
1922	4133	4043	98	0
1923	4133	3670	89	0
1924	3980	972	24	0
1925	4133	1445	35	0
1926	4133	2856	69	113
1927	4133	4032	98	124
1928	4133	3255	79	3
1929	3971	1070	26	0
1930	4133	2734	66	27
1931	4133	1086	26	0
1932	4116	1855	45	39
1933	4133	1966	48	6
1934	4133	1564	38	0
1935	3907	3562	86	59
1936	4133	3655	88	5
1937	4133	3189	77	65
1938	4133	4128	100	192
1939	3948	3443	83	1
1940	4133	3856	93	22
1941	3481	3472	84	0
1942	3881	3894	94	378
1943	4120	3591	87	375
1944	3711	3443	83	2
1945	3948	3574	86	123
1946	3969	3772	91	0
1947	3973	2602	63	0
1948	4133	2587	63	2
1949	3996	2656	64	0
1950	4133	2895	70	0
1951	4094	3994	97	230
1952	3510	3538	86	100

Table B-4 continued

Year	*Model Variable Demand*	*Model Delivery*	*Percent of Full Table A - 4.133 maf**	*Article 21 Supply*
1953	4063	3989	97	236
1954	4133	3830	93	6
1955	3995	1735	42	0
1956	4133	4127	100	129
1957	4029	3069	74	3
1958	3942	3910	95	335
1959	4133	3477	84	167
1960	4133	2021	49	0
1961	4133	2815	68	0
1962	3933	3153	76	2
1963	4133	4046	98	134
1964	4030	3050	74	0
1965	3966	3234	78	3
1966	4046	3844	93	61
1967	4033	3979	96	167
1968	4128	3583	87	398
1969	3583	3556	86	93
1970	4004	3929	95	398
1971	4133	4082	99	0
1972	4133	2727	66	0
1973	4119	3699	89	211
1974	4090	4107	99	147
1975	4113	4088	99	209
1976	4032	2789	67	0
1977	4133	830	20	0
1978	3898	3706	90	100
1979	4133	3512	85	89
1980	3751	3462	84	74
1981	4133	3400	82	0
1982	4009	4027	97	101
1983	3343	3370	82	200

Table B-4 continued

Year	*Model Variable Demand*	*Model Delivery*	*Percent of Full Table A - 4.133 maf**	*Article 21 Supply*
1984	4061	4079	99	379
1985	3905	3326	80	0
1986	3898	3011	73	52
1987	3923	2837	69	0
1988	4045	992	24	0
1989	4133	2895	70	0
1990	4133	1151	28	0
1991	4133	999	24	0
1992	4133	1155	28	0
1993	4133	4018	97	156
1994	4133	3042	74	0
Average	4026	3083	75	78
Maximum	4133	4128	100	398
Minimum	3343	830	20	0

Study: BST_2020D09D_ANNBENCHMARK_2_1
*4.133 maf per year is maximum Table A for deliveries from the Delta

Table B-5 Study 2021B SWP Delta water delivery (taf)

Year	*Model Fixed Demand*	*Model Delivery*	*Percent of Full Table A - 4.133 maf**	*Article 21 Supply*
1922	4133	4043	98	0
1923	4133	3670	89	0
1924	4133	972	24	0
1925	4133	1446	35	0
1926	4133	2856	69	113
1927	4133	4031	98	124
1928	4133	3255	79	3
1929	4133	1070	26	0
1930	4133	2734	66	27
1931	4133	1086	26	0
1932	4133	1855	45	39
1933	4133	1967	48	6
1934	4133	1564	38	0
1935	4133	3729	90	59
1936	4133	3669	89	0
1937	4133	3165	77	71
1938	4133	4129	100	197
1939	4133	3444	83	1
1940	4133	3856	93	22
1941	4133	4084	99	0
1942	4133	4122	100	75
1943	4133	3584	87	318
1944	4133	3465	84	3
1945	4133	3547	86	123
1946	4133	3801	92	0
1947	4133	2597	63	0
1948	4133	2586	63	2
1949	4133	2654	64	0
1950	4133	2893	70	0
1951	4133	3996	97	222
1952	4133	4133	100	14

Table B-5 continued

Year	*Model Fixed Demand*	*Model Delivery*	*Percent of Full Table A - 4.133 maf**	*Article 21 Supply*
1953	4133	3931	95	244
1954	4133	3860	93	33
1955	4133	1779	43	0
1956	4133	4126	100	111
1957	4133	3067	74	3
1958	4133	4063	98	306
1959	4133	3467	84	97
1960	4133	2007	49	0
1961	4133	2818	68	0
1962	4133	3153	76	2
1963	4133	4046	98	134
1964	4133	3050	74	0
1965	4133	3233	78	3
1966	4133	3853	93	56
1967	4133	4069	98	115
1968	4133	3584	87	398
1969	4133	4078	99	13
1970	4133	3933	95	358
1971	4133	4082	99	0
1972	4133	2725	66	0
1973	4133	3699	89	211
1974	4133	4133	100	143
1975	4133	4102	99	211
1976	4133	2775	67	0
1977	4133	830	20	0
1978	4133	3915	95	100
1979	4133	3493	85	98
1980	4133	3465	84	75
1981	4133	3387	82	0
1982	4133	4133	100	63
1983	4133	4133	100	160

Table B-5 continued

Year	*Model Fixed Demand*	*Model Delivery*	*Percent of Full Table A - 4.133 maf**	*Article 21 Supply*
1984	4133	4101	99	369
1985	4133	3322	80	0
1986	4133	3006	73	62
1987	4133	2835	69	0
1988	4133	993	24	0
1989	4133	2895	70	0
1990	4133	1151	28	0
1991	4133	999	24	0
1992	4133	1155	28	0
1993	4133	4018	97	156
1994	4133	3042	74	0
Average	4133	3130	76	68
Maximum	4133	4133	100	398
Minimum	4133	830	20	0

Study: BST_2020D09D-SWPTABLEA_5_1
*4.133 maf per year is maximum Table A for deliveries from the Delta

Appendix C
SWP Table A

What is Table A?

The contracts between the Department of Water Resources and the 29 State Water Project water contractors define the terms and conditions governing the water delivery and cost repayment for the SWP. Table A is an exhibit to these contracts. Comprehension of Table A is important in understanding the information in this report. To understand the table, it is necessary to understand how the contracts work.

All water-supply related costs of the SWP are paid by the contractors, and Table A serves as a basis for allocating some of the costs among the contractors. In addition, Table A plays a key role in the annual allocation of available supply among contractors. When the SWP was being planned, the amount of water projected to be available for delivery to the contractors was 4.2 million acre-feet (maf) per year. This was referred to as the minimum project yield, and it was recognized that in some years the project would be unable to deliver that amount and in other years project supply could exceed that amount. The 4.2 maf number was used as the basis for apportioning available supply to each contractor and as a factor in calculating each contractor's share of the project's costs. This apportionment is accomplished by Table A in each contract. Table A lists by year and acre-feet the portion of the 4.2 maf deliverable to each contractor. Other contract provisions permit changes to an individual contractor's Table A under special circumstances. The total of the maximums in all the contracts now equals 4.173 maf.

A copy of the consolidated Table A from all the contracts follows this explanation. The amounts listed in Table A cannot be viewed as an indication of the SWP water delivery reliability, nor should these amounts be used to support an expectation that a certain amount of water will be delivered to a contractor in any particular time span. Table A is simply a tool for apportioning available supply and cost obligations under the contract. In this report, reference to "Table A amounts" means the amounts listed in Table A. Contractors also receive other classifications of water from the project, as distinguished from Table A (for example, Article 21 water, makeup water, turnback pool water). These other contract provisions are discussed in Appendix D.

Table A

SWP Contractors	*Maximum Table A*
DELIVERED FROM THE DELTA	
North Bay	
Napa County FC&WCD	29,025
Solano County WA	47,756
Subtotal	76,781
South Bay	
Alameda County FC&WCD, Zone 7	78,000
Alameda County WD	42,000
Santa Clara Valley WD	100,000
Subtotal	220,000
San Joaquin Valley	
Oak Flat WD	5,700
County of Kings	4,000
Dudley Ridge WD	57,343
Empire West Side ID	3,000
Kern County WA	1,000,949
Tulare Lake Basin WSD	111,527
Subtotal	1,182,519
Central Coastal	
San Luis Obispo County FC&WCD	25,000
Santa Barbara County FC&WCD	45,486
Subtotal	70,486

SWP Contractors	*Maximum Table A*
Southern California	
Antelope Valley-East Kern WA	141,400
Castaic Lake WA	95,200
Coachella Valley WD	23,100
Crestline-Lake Arrowhead WA	5,800
Desert WA	38,100
Littlerock Creek ID	2,300
Mojave WA	75,800
Metropolitan WDSC	2,011,500
Palmdale WD	21,300
San Bernardino Valley MWD	102,600
San Gabriel Valley MWD	28,800
San Gorgonio Pass WA	17,300
Ventura County FCD	20,000
Subtotal	2,583,200
DELTA SUBTOTAL	4,132,986
Feather River	
County of Butte	27,500
Plumas County FC&WCD	2,700
City of Yuba City	9,600
Subtotal	39,800
GRAND TOTAL	4,172,786

The maximum Table A is not the Table A amount for 2001 in every contract. A few contractors have, for financial reasons and with the Department's approval, reduced the Table A amount in their contract for a specified time.

Appendix D
SWP Historical Deliveries

SWP Contract Water Types

The SWP contracts define several classifications of water available for delivery to contractors under specific circumstances. All classifications are considered "project" water. Many contractors make frequent use of these additional water types to increase or decrease the amount available to them under Table A.

Table A Water

Each contract's Table A is the amount in acre-feet that is used to determine the portion of available supply to be delivered to that contractor. Once that apportionment is made, the water delivered is further limited by monthly peaking rates (18 percent per month for agricultural contractors and 11 percent per month for urban contractors). Table A water is water delivered according to this apportionment methodology and is given first priority for delivery.

Article 21 Water

Article 21 of the contracts permits delivery of water excess to delivery of Table A and some other water types to those contractors requesting it. Contractors requesting Article 21 water may take delivery of water in excess of the monthly peaking rates that apply to Table A water. Article 21 water is apportioned to those contractors requesting it in the same proportion as their Table A.

Article 12(d)

When the State was unable to deliver any portion of a contractor's annual delivery under Table A as a result of causes beyond the State's control, contract provision Article 12(d) allowed the contractors to take the water later in the year or in succeeding years. As the Monterey amendment became effective (1995-1997), 12(d) water was deleted.

Makeup Water per Article 14(b)

Contractors whose Table A deliveries were curtailed due to outages may under specified circumstances request later deliveries of the Table A water that was undeliverable. This may result in a contractor receiving more than the Table A amount in a single year. The extra amount is "makeup water."

Turnback Pool Water

Contractors may choose to offer scheduled deliveries of Table A water to a pool, which is established in February and March. Other contractors may state a desire to receive this "turnback" pool water. Contributing contractors receive a reduction in charges and taking contractors pay extra.

Carryover Water

Pursuant to the long-term water supply contracts, the Department of Water Resources has offered contractors the opportunity to carry over a portion of their allocated water approved for delivery in the current year for delivery during the next year. The carryover program was designed to encourage the most effective and beneficial use of water and to avoid obligating the contractors to use or lose the water by December 31 of each year. The water supply contracts state the criteria of carrying over Table A water from one year to the next.

SWP Water Deliveries 1992-2001

1992

	Table A	Article 12(d)	Article 14(b)	Article 21	Turnback Pool	Carryover	Total
County of Butte	117						117
Plumas County FC&WCD	485						485
City of Yuba City	642						642
Napa County FC&WCD	3,146	38		1,156		817	5,157
Solano County WA	9,859	3,446				1,468	14,773
Alameda County FC&WCD, Zone 7	14,669						14,669
Alameda County WD	17,801					1,352	19,153
Santa Clara Valley WD	42,839						42,839
Oak Flat WD	2,239						2,239
County of Kings	1,806						1,806
Dudley Ridge WD	23,770						23,770
Empire West Side ID	1,354						1,354
Kern County WA	480,462					2,758	483,220
Tulare Lake Basin WSD	46,728						46,728
San Luis Obispo County FC&WCD	0						0
Santa Barbara County FC&WCD	0						0
Antelope Valley-East Kern WA	28,041					2,224	30,265
Castaic Lake WA	17,863					2,836	20,699
Coachella Valley WD	10,427						10,427
Crestline-Lake Arrowhead WA	519						519
Desert WA	17,197						17,197
Littlerock Creek ID	251						251
Mojave WA	10,686						10,686
Metropolitan WDSC	629,486					80,827	710,313
Palmdale WD	4,035						4,035
San Bernardino Valley MWD	3,358						3,358
San Gabriel Valley MWD	7,908						7,908
San Gorgonio Pass WA	0						0
Ventura County FCD	0						0
Totals	1,375,688	3,484		1,156		92,282	1,472,610

1993

	Table A	Article 12(d)	Article 14(b)	Article 21	Turnback Pool	Carryover	Total
County of Butte	256						256
Plumas County FC&WCD	444						444
City of Yuba City	746						746
Napa County FC&WCD	5,246					40	5,286
Solano County WA	26,130	1,999				1,051	29,180
Alameda County FC&WCD, Zone 7	32,921					714	33,635
Alameda County WD	10,271						10,271
Santa Clara Valley WD	61,572					493	62,065
Oak Flat WD	4,831					27	4,858
County of Kings	4,000						4,000
Dudley Ridge WD	48,344					2,274	50,618
Empire West Side ID	2,741						2,741
Kern County WA	1,127,774					40,156	1,167,930
Tulare Lake Basin WSD	117,708					6,760	124,468
San Luis Obispo County FC&WCD	0						0
Santa Barbara County FC&WCD	0						0
Antelope Valley-East Kern WA	41,452					1,650	43,102
Castaic Lake WA	23,039					0	23,039
Coachella Valley WD	23,100						23,100
Crestline-Lake Arrowhead WA	439						439
Desert WA	38,100						38,100
Littlerock Creek ID	734						734
Mojave WA	11,514						11,514
Metropolitan WDSC	487,381					164,809	652,190
Palmdale WD	7,572					189	7,761
San Bernardino Valley MWD	2,959					1,402	4,361
San Gabriel Valley MWD	14,180					217	14,397
San Gorgonio Pass WA	0						0
Ventura County FCD	0						0
Totals	2,093,454	1,999				219,782	2,315,235

1994

	Table A	*Article 12(d)*	*Article 14(b)*	*Article 21(b)*	*Turnback Pool*	*Carryover*	*Total*
County of Butte	329						329
Plumas County FC&WCD	492						492
City of Yuba City	1,035						1,035
Napa County FC&WCD	3,601			3,191			6,792
Solano County WA	15,222			10,034			25,256
Alameda County FC&WCD, Zone 7	20,183			359			20,542
Alameda County WD	21,914			997			22,911
Santa Clara Valley WD	52,896			4,219			57,115
Oak Flat WD	3,005			66			3,071
County of Kings	2,116						2,116
Dudley Ridge WD	27,535			1,258			28,793
Empire West Side ID	969			697			1,666
Kern County WA	598,685			58,474			657,159
Tulare Lake Basin WSD	36,562			25,800			62,362
San Luis Obispo County FC&WCD	0						0
Santa Barbara County FC&WCD	0						0
Antelope Valley-East Kern WA	47,663			1,490			49,153
Castaic Lake WA	25,552			889			26,441
Coachella Valley WD	12,219			1,883			14,102
Crestline-Lake Arrowhead WA	785						785
Desert WA	20,153			3,104			23,257
Littlerock Creek ID	1,098						1,098
Mojave WA	16,836			16			16,852
Metropolitan WDSC	807,866						807,866
Palmdale WD	8,270			148			8,418
San Bernardino Valley MWD	9,135						9,135
San Gabriel Valley MWD	15,230						15,230
San Gorgonio Pass WA	0						0
Ventura County FCD	0						0
Totals	1,749,351			112,625			1,861,976

1995

	Table A	*Article 12(d)*	*Article 14(b)*	*Article 21*	*Turnback Pool*	*Carryover*	*Total*
County of Butte	203						203
Plumas County FC&WCD	308						308
City of Yuba City	910						910
Napa County FC&WCD	5,182						5,182
Solano County WA	21,345						21,345
Alameda County FC&WCD, Zone 7	30,091						30,091
Alameda County WD	17,793						17,793
Santa Clara Valley WD	28,756						28,756
Oak Flat WD	5,169						5,169
County of Kings	4,000						4,000
Dudley Ridge WD	57,700					2,986	60,686
Empire West Side ID	957			106		568	1,631
Kern County WA	1,089,063			59,671		2,795	1,151,529
Tulare Lake Basin WSD	71,679			4,553		25,637	101,869
San Luis Obispo County FC&WCD	0						0
Santa Barbara County FC&WCD	0						0
Antelope Valley-East Kern WA	47,286						47,286
Castaic Lake WA	25,660					1,573	27,233
Coachella Valley WD	23,100						23,100
Crestline-Lake Arrowhead WA	409						409
Desert WA	38,100						38,100
Littlerock Creek ID	480						480
Mojave WA	3,722		5,000				8,722
Metropolitan WDSC	396,600		20,000			19,442	436,042
Palmdale WD	6,961						6,961
San Bernardino Valley MWD	696						696
San Gabriel Valley MWD	12,922						12,922
San Gorgonio Pass WA	0						0
Ventura County FCD	0						0
Totals	1,889,092		25,000	64,330		53,001	2,031,423

1996

	Table A	Article 12(d)	Article 14(b)	Article 21	Turnback Pool	Carryover	Total
County of Butte	257						257
Plumas County FC&WCD	360						360
City of Yuba City	820						820
Napa County FC&WCD	4,893						4,893
Solano County WA	29,144					855	29,999
Alameda County FC&WCD, Zone 7	18,903						18,903
Alameda County WD	19,662						19,662
Santa Clara Valley WD	88,829					1,021	89,850
Oak Flat WD	4,904						4,904
County of Kings	4,000						4,000
Dudley Ridge WD	52,491			4,457			56,948
Empire West Side ID	1,371					497	1,868
Kern County WA	1,117,060			15,653		52,350	1,185,063
Tulare Lake Basin WSD	118,500			8,537	71,268	38,570	236,875
San Luis Obispo County FC&WCD	100						100
Santa Barbara County FC&WCD	0						0
Antelope Valley-East Kern WA	56,356						56,356
Castaic Lake WA	32,500						32,500
Coachella Valley WD	23,100				39,119		62,219
Crestline-Lake Arrowhead WA	485						485
Desert WA	38,100				64,522		102,622
Littlerock Creek ID	494						494
Mojave WA	7,427						7,427
Metropolitan WDSC	553,259					40,121	593,380
Palmdale WD	11,434						11,434
San Bernardino Valley MWD	6,064						6,064
San Gabriel Valley MWD	15,989						15,989
San Gorgonio Pass WA	0						0
Ventura County FCD	0						0
Totals	2,206,502	0	0	28,647	174,909	133,414	2,543,472

1997

	Table A	Article 12(d)	Article 14(b)	Article 21	Turnback Pool	Carryover	Total
County of Butte	185						185
Plumas County FC&WCD	231						231
City of Yuba City	1,005						1,005
Napa County FC&WCD	4,341						4,341
Solano County WA	35,530						35,530
Alameda County FC&WCD, Zone 7	27,522						27,522
Alameda County WD	24,063						24,063
Santa Clara Valley WD	95,601						95,601
Oak Flat WD	5,238						5,238
County of Kings	0						0
Dudley Ridge WD	51,623			7,141	12,544		71,308
Empire West Side ID	0						0
Kern County WA	1,092,543			10,264			1,102,807
Tulare Lake Basin WSD	21,156			1,213			22,369
San Luis Obispo County FC&WCD	1,199						1,199
Santa Barbara County FC&WCD	7,439						7,439
Antelope Valley-East Kern WA	61,752			641			62,393
Castaic Lake WA	27,712						27,712
Coachella Valley WD	23,100				35,000		58,100
Crestline-Lake Arrowhead WA	651						651
Desert WA	38,100				15,000		53,100
Littlerock Creek ID	444						444
Mojave WA	10,374						10,374
Metropolitan WDSC	721,810						721,810
Palmdale WD	11,861						11,861
San Bernardino Valley MWD	9,654						9,654
San Gabriel Valley MWD	16,002			2,173			18,175
San Gorgonio Pass WA	0						0
Ventura County FCD	1,850						1,850
Totals	2,290,986			21,432	62,544		2,374,962

1998

	Table A	*Article 12(d)*	*Article 14(b)*	*Article 21*	*Turnback Pool*	*Carryover*	*Total*
County of Butte	527						527
Plumas County FC&WCD	0						0
City of Yuba City	1,054						1,054
Napa County FC&WCD	5,359						5,359
Solano County WA	21,377			9,982		407	31,766
Alameda County FC&WCD, Zone 7	17,941						17,941
Alameda County WD	19,075						19,075
Santa Clara Valley WD	62,526					884	63,410
Oak Flat WD	4,401						4,401
County of Kings	3			12			15
Dudley Ridge WD	52,919			984		1,747	55,650
Empire West Side ID	0					542	542
Kern County WA	856,906					1,684	858,590
Tulare Lake Basin WSD	11,367			9,310			20,677
San Luis Obispo County FC&WCD	3,592						3,592
Santa Barbara County FC&WCD	18,618						18,618
Antelope Valley-East Kern WA	52,926						52,926
Castaic Lake WA	20,093						20,093
Coachella Valley WD	23,100				55,000		78,100
Crestline-Lake Arrowhead WA	187						187
Desert WA	38,100				20,000		58,100
Littlerock Creek ID	404						404
Mojave WA	3,925						3,925
Metropolitan WDSC	370,313		17,180			33,672	421,165
Palmdale WD	8,752						8,752
San Bernardino Valley MWD	1,878						1,878
San Gabriel Valley MWD	9,310						9,310
San Gorgonio Pass WA	0						0
Ventura County FCD	1,850						1,850
Totals	1,606,503	0	17,180	20,288	75,000	38,936	1,757,907

1999

	Table A	Article 12(d)	Article 14(b)	Article 21	Turnback Pool	Carryover	Total
County of Butte	286						286
Plumas County FC&WCD	0						0
City of Yuba City	1,096						1,096
Napa County FC&WCD	4,550			754			5,304
Solano County WA	37,753						37,753
Alameda County FC&WCD, Zone 7	46,000			2,910			48,910
Alameda County WD	34,871			2,781			37,652
Santa Clara Valley WD	67,465			15,480			82,945
Oak Flat WD	4,871						4,871
County of Kings	4,000						4,000
Dudley Ridge WD	51,870			4,990	6,566		63,426
Empire West Side ID	3,000			176			3,176
Kern County WA	1,077,755			58,241	42,154		1,178,150
Tulare Lake Basin WSD	118,500			49,898	121,337		289,735
San Luis Obispo County FC&WCD	3,743						3,743
Santa Barbara County FC&WCD	20,137						20,137
Antelope Valley-East Kern WA	69,073						69,073
Castaic Lake WA	32,899						32,899
Coachella Valley WD	23,100				27,380		50,480
Crestline-Lake Arrowhead WA	1,132						1,132
Desert WA	38,100				20,000		58,100
Littlerock Creek ID	342						342
Mojave WA	5,144						5,144
Metropolitan WDSC	829,777			22,840			852,617
Palmdale WD	13,278						13,278
San Bernardino Valley MWD	12,874						12,874
San Gabriel Valley MWD	18,000						18,000
San Gorgonio Pass WA	0						0
Ventura County FCD	1,850						1,850
Totals	2,521,466			158,070	217,437		2,896,973

2000

	Table A	*Article 12(d)*	*Article 14(b)*	*Article 21*	*Turnback Pool*	*Carryover*	*Total*
County of Butte	586						586
Plumas County FC&WCD							0
City of Yuba City	901						901
Napa County FC&WCD	3,136			297		1,525	4,958
Solano County WA	32,882			1,040		1,417	35,339
Alameda County FC&WCD, Zone 7	53,877			3,740			57,617
Alameda County WD	33,598			2,380			35,978
Santa Clara Valley WD	70,433			18,381		13,174	101,988
Oak Flat WD	4,494					14	4,508
County of Kings	3,600						3,600
Dudley Ridge WD	38,673			7,454	12,193	2,884	61,204
Empire West Side ID	1,271						1,271
Kern County WA	826,654			78,908	232,405	13,193	1,151,160
Tulare Lake Basin WSD	98,595			56,818	27,073	15,827	198,313
San Luis Obispo County FC&WCD	3,962						3,962
Santa Barbara County FC&WCD	22,741						22,741
Antelope Valley-East Kern WA	83,577						83,577
Castaic Lake WA	40,680						40,680
Coachella Valley WD	20,790			17,820	3,713		42,323
Crestline-Lake Arrowhead WA	1,194						1,194
Desert WA	34,290			17,820	6,124		58,234
Littlerock Creek ID	0						0
Mojave WA	9,135						9,135
Metropolitan WDSC	1,274,951			103,124		169,529	1,547,604
Palmdale WD	8,221					839	9,060
San Bernardino Valley MWD	18,399						18,399
San Gabriel Valley MWD	14,000			475			14,475
San Gorgonio Pass WA	0						0
Ventura County FCD	4,050						4,050
Totals	2,704,690			308,257	281,508	218,402	3,512,857

2001

	Table A	Article 12(d)	Article 14(b)	Article 21	Turnback Pool	Carryover	Total
County of Butte	513						513
Plumas County FC&WCD							0
City of Yuba City	1,065						1,065
Napa County FC&WCD	3,876			464	82	1,723	6,145
Solano County WA	17,756			2,304		1,021	21,081
Alameda County FC&WCD, Zone 7	22,307				308	5,990	28,605
Alameda County WD	13,695			10	107	4,192	18,004
Santa Clara Valley WD	35,689					12,233	47,922
Oak Flat WD	2,061				22	101	2,184
County of Kings	1,560						1,560
Dudley Ridge WD	18,487			933	347	6,815	26,582
Empire West Side ID						1,107	1,107
Kern County WA	380,338			23,253	6,502	92,052	502,145
Tulare Lake Basin WSD	41,289			8,755	769	7,389	58,202
San Luis Obispo County FC&WCD	4,184				99		4,283
Santa Barbara County FC&WCD	14,162			396	296		14,854
Antelope Valley-East Kern WA	44,643				899		45,542
Castaic Lake WA	30,471			850	618		31,939
Coachella Valley WD	9,009				91		9,100
Crestline-Lake Arrowhead WA	1,057						1,057
Desert WA	14,859				151		15,010
Littlerock Creek ID							0
Mojave WA	4,357						4,357
Metropolitan WDSC	684,505			10,415	7,949	200,000	902,869
Palmdale WD	8,170					2,257	10,427
San Bernardino Valley MWD	26,488						26,488
San Gabriel Valley MWD	6,534						6,534
San Gorgonio Pass WA							0
Ventura County FCD	1,850						1,850
Totals	1,388,925			47,380	18,240	334,880	1,789,425